7

CHAPTER

Desktop Components– Word Processor, Presentation Software and Spreadsheets

LEARNING OUTCOMES

- ☐ Word Processor and its features
- ☐ Presentation Software and its features
- ☐ MS-EXCEL, its features and its applications

7.0 INTRODUCTION TO WORD PROCESSOR

A word processor is a type of software application used for composing, editing, formatting and printing documents. Word processors have a variety of uses and applications within the business environment, at home and in educational contexts.

Word processors are used to create, edit and print documents, and well as save them electronically. Today, the word processor is one of the most frequently used software programs on a computer, with Microsoft Word being the most popular word processor.

Word processing includes several tools to format the pages. For example, text can be organized into columns, add page numbers, insert illustrations, etc. However, word processing does not give complete control over the look and feel of the document. When design becomes important, one may need to use desktop publishing software to give more control over the layout of the pages.

Word processing software typically also contains features to make it easier to perform repetitive tasks. For example, let's say one need to send a letter to all his/her customers regarding a new policy. The letter is the same for all customers except for the name and address at the top of the letter. A mail merge function allows to produce all the letters using one template document and a table with customer names and addresses in the database.

Text editors shouldn't be confused with word processing software. While they do also allow to create, edit and save text documents, they only work on plain text. Text editors don't use any formatting, such as underlined text or different fonts. Text editors serve a very different purpose from word processing software. They are used to work with files in plain text format, such as source code of computer programs or configuration files of an operating system. An example of a text editor would be Notepad on the Windows platform.

Word processors can be used to create multiple types of files, including text files (.txt), rich text files (.rtf), HTML files (.htm & .html), and Wordfiles (.doc & .docx). Some word processors can also be used to create XML files (.xml).

The basic layout of the Microsoft Word is shown in Figure 7.1. In a word processor, blank white sheet is presented. The text is added to the document area and after it has been inserted formatted or adjusted to the user's preference.

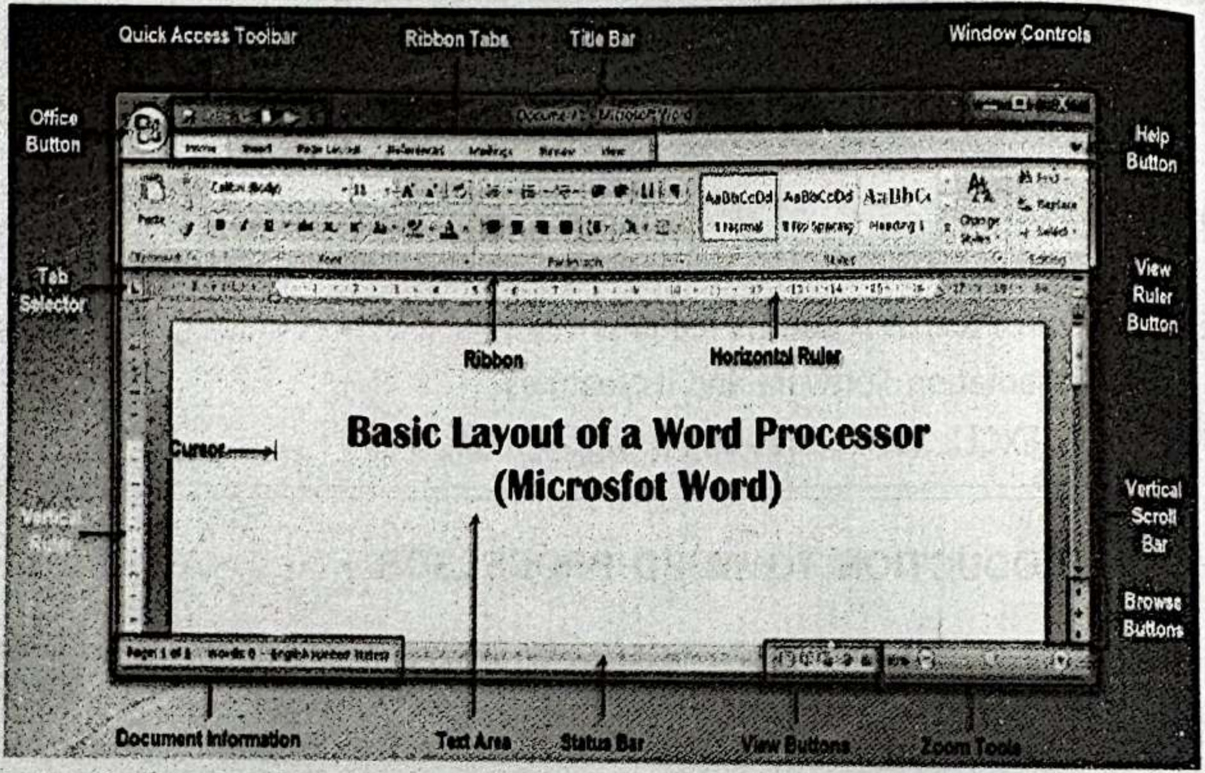

Quick Access Toolbar
Ribbon Tabs
Title Bar
Window Controls
Office Button
Help Button
Tab Selector
View Ruler Button
Ribbon
Horizontal Ruler
Cursor
Basic Layout of a Word Processor
(Microsfot Word)
Vertical Ruler
Vertical Scroll Bar
Browse Buttons
Document Information
Text Area
Status Bar
View Buttons
Zoom Tools

Figure 7.1: Basic Layout of Microsoft word

Apart from MS word, other word processors are shown in Figure 7.2

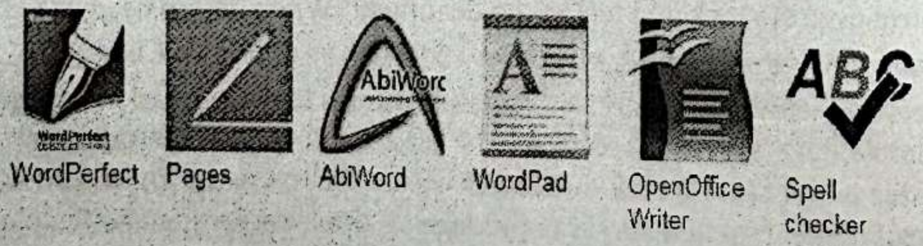

WordPerfect
Pages
AbiWord
WordPad
OpenOffice Writer
Spell checker

Figure 7.2 : Examples of Word processor

7.1 FEATURES OF A WORD PROCESSOR

Unlike a basic plaintext editor, a word processor offers dozens of additional features that can give the document or other text a more professional appearance. Below is a listing of some of the most popular features of a word processor.

Basic Features :

1. **Insert** : This feature helps to insert text, images shapes etc in the document. Any text can be inserted into the document by placing the insertion point where text need to be added.
2. **Copy** : This feature helps in duplicating the text in various other documents. This can be done by selecting the text, then right click, then select copy command. This feature will help to copy the text in other documents keeping the text in the original document intact. The keyboard shortcut for copy is Ctrl +C.
3. **Cut and paste** : Cut command removes the text from the original document. The keyboard shortcut for cut is Ctrl + X. Paste command helps in inserting the copied text in another document. The keyboard shortcut for paste is Ctrl +V.
4. **Delete** : This feature helps to remove the characters/text from the document.
5. **Find and replace** : This feature can be used when one need to search for a specific word, number, or phrase in a document and replace it with something else. This is quite useful if one need to make a lot of replacements at once like changing the name of the main character in a novel one has written or something one have consistently misspelled.Fortunately, Word can be told to make all of the changes automatically. Numbers, punctuation, and even cap or uncap words can also be replaced; just type what to find and what to replace it with.The keyboard shortcut Ctrl + H will also open the Find and Replace button.
6. **Print** : This feature allows to send a document to the printer to get the hardcopy
7. **Word wrap** : In word processing, a feature that causes the word processor to force all text to fit within the defined margins. When one line is filled with text, the word processor automatically jumps to the next line so that it is not required to keep track of line lengths and to press the Return key after each line. The word processor divides lines in such a way that a word is never split between two lines (unless the word processor supports *hyphenation*). Word wrap also occurs if the margins are changed. In this case, the word processor readjusts all the text so that it fits within the new margins.

Advanced Features :

1. **File management** : A file management system is a type of software that manages data files in a computer system. It has limited capabilities and is designed to manage individual or group files, such as special office documents and records. It may display report details, like owner, creation date, state of completion and similar features useful in an office environment. A file management system is also known as a file manager.
2. **Graphics** : *Graphic* design is an *important* tool that enhances how to communicate with other people. It serves to convey the ideas in a way that is not only effective, but also beautiful. Word processor allows to add graphics like charts, pictures, animations, audio, video etc into a word document.

3. **Font specification** - The fonts add value to the text. It helps readers to perceive information from the text. The correct choice of color, font and text size can prove to be vital for attracting the target audience. It's easy to attract the readers using typography but holding their attention requires more creativity. Word processor allows to add various fonts into the document. One can change the font type, size, color etc as per the requirement making the document more attractive and easier to understand.

4. **Footnotes and Cross reference** : Word processors automate the placement of footnotes and enable easy cross-reference of other sections of the document.

5. **Headers and footers** : Headers and footers are typically used in multiple-page documents to display descriptive information. In addition to page numbers, a header or footer can contain information such as: The document name, the date and/or time the document is created or revised, an author name, a graphic, a draft or revision number.

6. **Macros** : In Word, one can automate frequently used tasks by creating and running macros. A macro is a series of commands and instructions that are group together as a single command to accomplish a task automatically.

7. **Layout** : In word processing and desktop publishing, layout refers to the arrangement of text and graphics. The layout of a document can determine which points are emphasized, and whether the document is aesthetically pleasing.

   While no computer program can substitute for a professional layout artist, a powerful desktop publishing system can make it easier to lay out professional-looking documents. WYSIWYG (What you see is what you get) helps layout considerably because it allows to lay out a document on the display screen and see what it will look like when printed.

8. **Spell check:** When it comes to presenting a document to clients, professors or any audience, saying something smart and valuable matters. However, most people are likely to overlook the great content if it is riddled with typos, misspellings and mistakes. Producing flawless copy is a mark of professionalism; most companies expect nothing less in their documentation. One useful tool computer users can employ to edit their documents is a spell checker program or the spell checking functions offered by their word processor.

   Spell check functions or spell checkers are software applications that check words against a digital dictionary to ensure they are spelled correctly. Words that the spell checker identifies as misspelled are typically highlighted or underlined. One main benefit of using a spell checker is its accuracy. Running a spell checker ensures that the number of typos in the document decreases significantly.

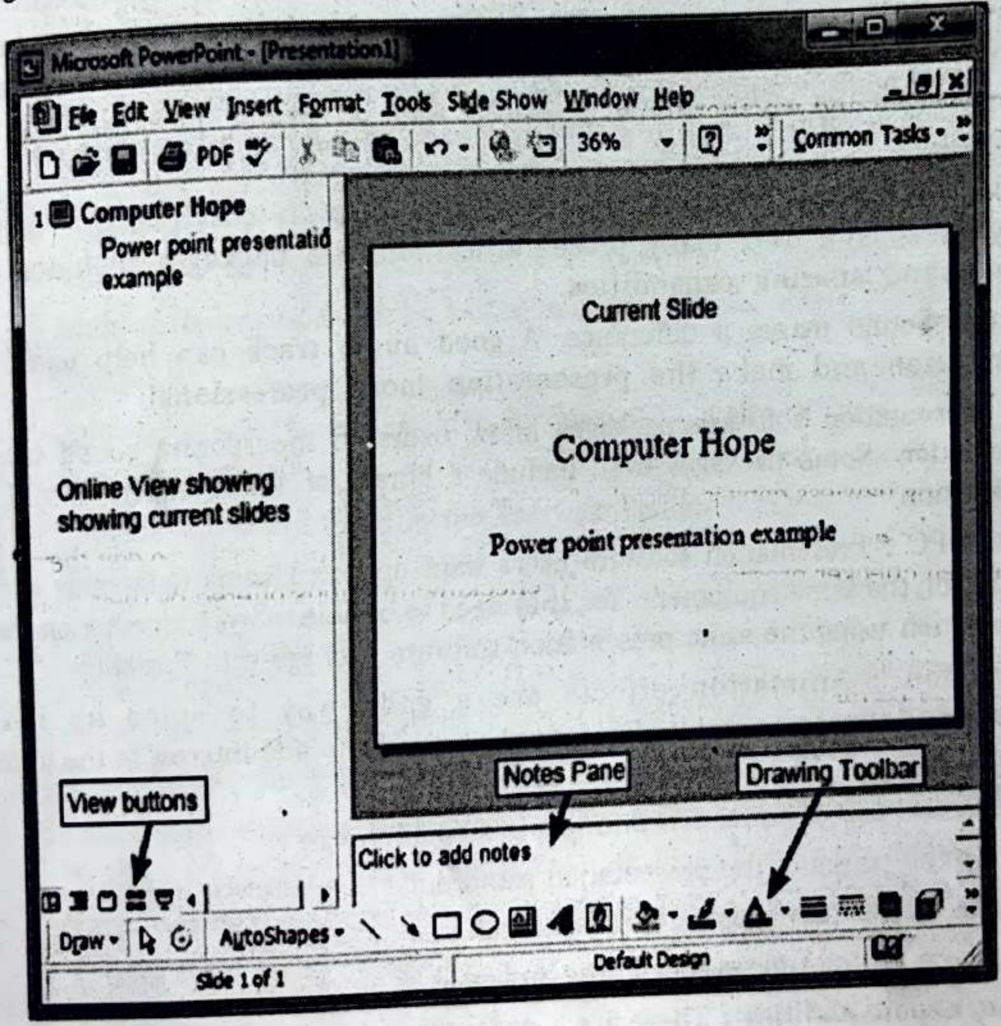
9. **Thesaurus:** Most word processors have in-built thesaurus that allows to search for synonym without leaving the word processor.

10. **Merges:** Merge feature in word processor allows to merge text from one file to another. This is particularly useful for generating many files that have same format but different data. Example includes generating mailing labels.

11. **Table of contents and Indices:** This feature allows the automatic creation of table of contents and index based on special codes that is inserted into the document.

7.2 PRESENTATION SOFTWARE

Presentation software (sometimes called "presentation graphics") is a category of applicationprogram used to create sequences of words and pictures that tell a story or help support a speech or public presentation of information. Presentation software can be divided into business presentation software and more general multimedia authoring tools, with some products having characteristics of both. Business presentation software emphasizes ease- and quickness-of-learning and use. Multimedia authoring software enables to create a more sophisticated presentation that includes audio and video sequences. Business presentation software usually enables one to include images and sometimes audio and video developed with other tools. In other words, a presentation program is a software program that helps create a slideshow that addresses a topic and can be used for various purpose like businesses and schools for discussing a topic or for teaching. Many times, the presenter uses a projector to project the slideshow up on to screen that everyone can see. Below is an example of Microsoft PowerPoint, a commonly used program that creates presentations.


Microsoft PowerPoint - [Presentation1]
File Edit View Insert Format Tools Slide Show Window Help
PDF
36%
Common Tasks
1 Computer Hope
Power point presentatio
example
Current Slide
Computer Hope
Power point presentation example
Online View showing
showing current slides
View buttons
Notes Pane
Drawing Toolbar
Click to add notes
Draw
AutoShapes
Slide 1 of 1
Default Design

Examples of Presentation software

Prezi
Microsoft PowerPoint
Google Slides
Keynote
Zoho Office Suite
Office Sway
WPS Office

7.3 FEATURES OF PRESENTATION SOFTWARE

1. Real-Time Collaboration : In today's teamwork-oriented environment, real-time coordination is an important consideration for presentation software. Real-time collaboration allows team members to work together on the same document at the same time.
2. Creative Design Tools : Most of the presentation software has a set of creative design tools. .Those tools are used to design a visually attractive creative presentation that'll stand out and capture the audience's attention and interest. This includes the ability to add shapes as well as control the colors used in the presentation.
3. Mobile Editing : Clearly, mobile devices are important in today's culture. To be most useful to today's user, many presentation software packages includes mobile editing and sharing capabilities.
4. Audio : Sound makes a difference. A good audio track can help users retain information and make the presentation more professional.

   The presentation software packages allow users to incorporate sound into their presentation. Some packages even include a library of sound effects to add to the presentation.
5. Mac vs PC : Presentation software users want options. Teams today may not all be working on the same equipment. Yet, they need to be able to work together on the same presentation using the same presentation software package with flexibility.
6. Animation : Animation effects are a good way to spice up the presentation. Animation presentation software are used to add interest to the transitions between slides or to add details to a slide.
   - Effective use of animation during a presentation can :
   - help the points of the presentation stand out.
   - pace the delivery process of presentation.
   - make a lasting impression on the audience.
7. Import/Export Abilities : There are a wide variety of presentation software program packages available. If one work with presentations, chances are that one will need to import a presentation from another package. Also, one may need to export a presentation for another user.

8. **Online Sharing** : The ability to share a presentation online is important in two regards:

   Online editing tools allow for collaboration.

   Online publishing tools allow to share the presentation on the Web.

9. **Technical Support** : Strong technical support is important for nearly all software packages. Presentation software packages are no different. If one is new to creating presentations or if he/she work with a team that's got varying levels of expertise, be sure to select a presentation software option that offers strong technical support.

10. **Template Availability** : Using a professional template for the presentation can save hours of time. It can also help to create a more effective presentation.Fortunately, many presentation software tools include templates and many templates are available through third parties.

7.4 SPREADSHEETS

An Electronic Spreadsheet or worksheet is like a large sheet of paper ruled-off into columns and rows to form boxes or cells, it is used to store information in the memory of the computer, calculate results and display information and result in a desired manner on the computer screen. In such a worksheet, information is entered through keyboard and displayed on the screen. Data entered in the worksheet can be easily changed and can be used for calculations. If some information (data) is altered, then worksheet will automatically recalculate the results.

All kinds of information can be stored in a spreadsheet. Some common applications are:

- Budgets
- Annual Reports
- Payroll
- Income Statement and Income Tax Calculations
- Inventory Control
- Scientific Calculations
- Invoices or Bills
- Investment and Loan Analysis
- Cost-effective Analysis (using IF-THEN)

The electronic worksheet offers several advantages over the paper spreadsheet

1. It is much faster and easier to make modifications to it and to make both electronic and paper copies of it.
2. It gives result more accurately.
3. It provides several built-in functions which perform complicated problems more rapidly.
4. At a given time one can only see a part of the whole sheet. To see parts which are not visible, we need to 'scroll in' only those parts. It is like seeing the spreadsheet through a window.

5. In addition to allowing numbers and text it allows formulas (such as Contribution Revenue-Variable Cost) to be entered into the worksheet. This enables very rapid recalculation to be done under frequently changed assumptions.
6. It enables to draw various types of graphs to understand the numbers/figures easily.
7. An Electronic worksheet can easily and quickly produce reports and get answers to "what-if' questions e.g., one can instantly determine what the sales target for the last quarter should be if he/she want to increase net profit for the year by 20%.

7.5 MS-EXCEL

The Excel spreadsheet helps to create, view, edit, and share the files with others quickly and easily. It also helps to manage charts, data analyses and more while one view and edit workbooks attached to email messages.

✓ **Microsoft Excel Features :**

1. Create Spreadsheets & Calculate
   - Manage charts, budgets, task lists, accounting, or financial analysis with Excel's modern templates.
   - Use data analysis tools and familiar formulas to run calculations.
   - Rich Office features and formatting options make the workbook easier to read and use.
   - All charts and spreadsheet features, formats, and formulas operate the same way, no matter which device is used.
2. Review and Edit
   - Review the Excel files from any device.
   - Edit charts and data or update the task list from anywhere.
   - Use data analysis features like sort and filter columns to focus the review.
   - Create spreadsheets, duplicate, hide, and unhide easily.
   - Annotate charts with notes, highlight portions of the worksheet, create shapes, or write math equations using ink with the draw tab feature on devices with touch capabilities.
3. Data Analysis
   - Insert charts to bring the data to life.
   - Use data analysis features like add and edit chart labels to highlight key insights.
4. Collaborate and Work Anywhere
   - Share charts and files with a few taps to quickly invite others to edit, view, or leave comments directly in the workbooks.
   - Copy the worksheet in the body of an email message with its format intact or attach or copy a link to the workbook for other sharing options.

7.6 APPLICATION OF MS-EXCEL

1. **Uses of Microsoft Excel in Education :** Teachers can use table styles, shapes, charts, data tools, and formulas to teach students in the classrooms. Students can learn and solve basic and logical-mathematical problems and statistics in excel.

   Teachers can educate by creating a table in Excel sheet. They can highlight more interesting cells in colors, emphasize important values and visualize data using bars and charts.

2. **Uses of Microsoft Excel in Business :** I don't think the business owner, either small or big company can be productive and managed without the use of Microsoft Excel.

   Microsoft Excel application can be used in various business operations. Such as goal setting, budgeting process, and planning, team management, accounts management, income, and expenses calculation, product and service valuation and management of client's data etc. in business.

   The uses of Microsoft Excel in business make such daily official operations faster, accurate and predictable. Because Excel provides great features such as filters, charts, conditional formatting and pivot table, logical and financial formulas. The various uses of Excel in business are as follows:-

   (a) **In Goal Setting and Planning :** Goal setting and planning is a task that all we do repeatedly each day. Goal setting and planning is very important for everyone from students to business owners. But goal setting and planning takes white paper, time and lots of calculation but if one uses Excel then it becomes very easy and environmentally friendly.

   (b) **For Business Owners :** Online business owners or offline can use Excel to manage their daily life work. Such as work progress, team management, pay-outs details, business progress. Such as if one wants to track his/her marketing campaign progress then go to file->new->template and search for a marketing campaign and the output will be pre-designed and formulated cells.

   (c) **ForExpense Calculation :** Excel can be used to manage the daily expenses and can be used to create monthly expenses report.

   (d) **In Daily Progress Report :** Many online and offline companies and clients making it mandatory for virtual and offline staff to maintain their daily progress report. It is not only beneficial for employees but also for companies to track daily progress report. One can create a table with Date, Time, Client, Task, Duration, and status etc. according to demand from clients or manager.

3. **Uses of Microsoft Excel for Data Analysis :** Data analysis is very important to work today for an online business or website owners (eCommerce, blog, forums etc.). Such as from tracking website visitors, products sell, customer reviews, marketing campaigns, user behaviour and events etc. Such work is very time and brain consuming especially when things are not going according to the plan.

Microsoft Excel application provides great benefit for online business owners and customers. Such as by filtering user's data by country, filtering user by age, adding conditional formulas in big data etc. are common daily tasks that can be handled smartly in excel.

REVIEW QUESTIONS

1. What is a word processor? Give its various examples.
2. Explain the several features of word processor
3. What is a presentation software? Give its various examples
4. Explain the several features ofpresentation software
5. What is a Spreadsheet? Give its various examples.
6. Explain the several features of MS-EXCEL.
7. What are the various applications of MS-EXCEL? Explain in detail.

8

CHAPTER

Functions in Excel

LEARNING OUTCOMES

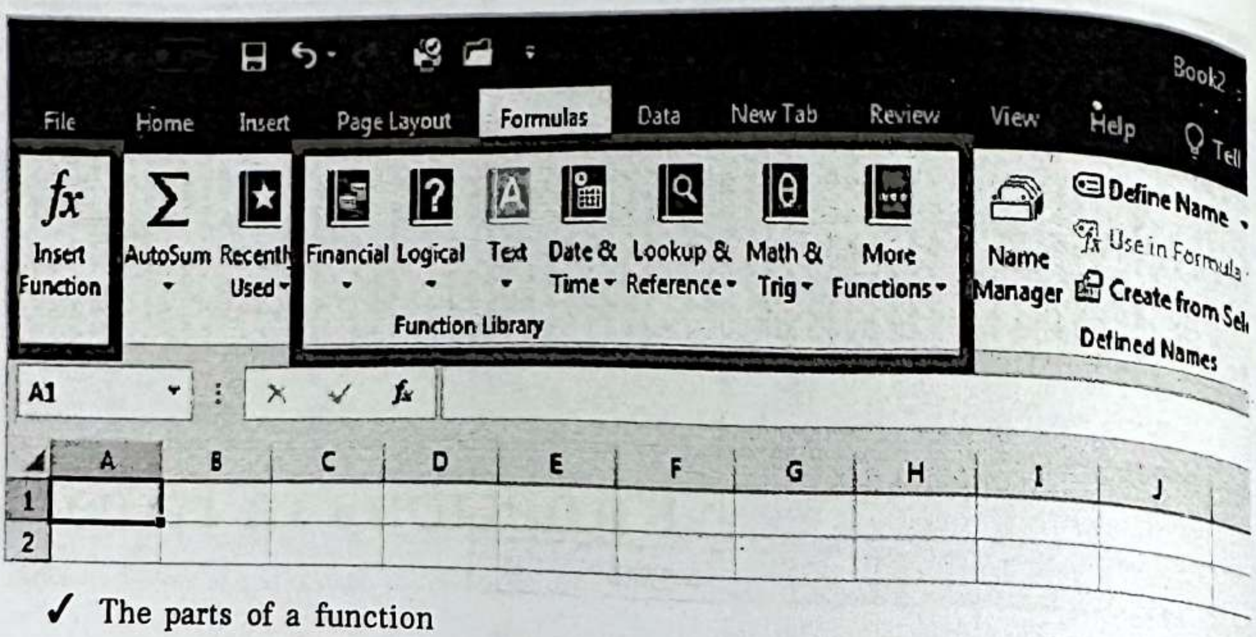
- ☐ Creation of Tables in Excel and its formatting
- ☐ Creation of Graphs and Charts in EXCEL and its formatting
- ☐ Various functions used in EXCEL – Mathematical, Statistical, Financial, Text, Date and Time functions
- ☐ Worksheet Management
- ☐ Analyze data using Pivot tables
- ☐ Creation and management of Scenarios and Summaries

8.0 FUNCTIONS IN EXCEL

A formula is an expression which calculates the value of a cell. Functions are predefined formulas and are already available in Excel. The various Functions available in EXCEL are

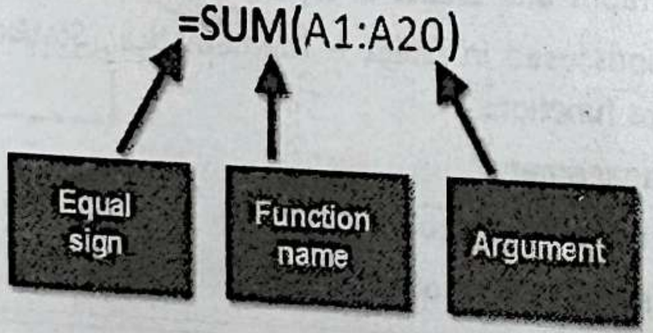
Following are the steps to insert Functions in EXCEL :

1. Click on the Formula Tab
2. Either Click on Insert Function Wizard or Click on the Function to be inserted.


Book2
File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
More Functions
Function Library
Name Manager
Define Name
Use in Formula
Create from Sel
Defined Names
A1
A
B
C
D
E
F
G
H
I
J
1
2

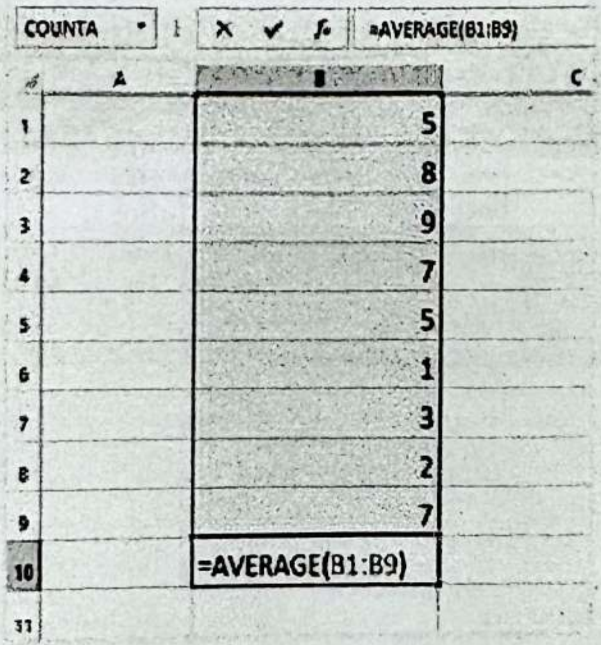
✓ The parts of a function

In order to work correctly, a function must be written a specific way, which is called the syntax. The basic syntax for a function is the equals sign (=), the function name (SUM, for example), and one or more arguments. Arguments contain the information to be calculated. The function in the example below would add the values of the cell range A1:A20.


=SUM(A1:A20)
Equal sign
Function name
Argument

Arguments can refer to both individual cells and cell ranges and must be enclosed within parentheses. one argument or multiple arguments can be included, depending on the syntax required for the function.

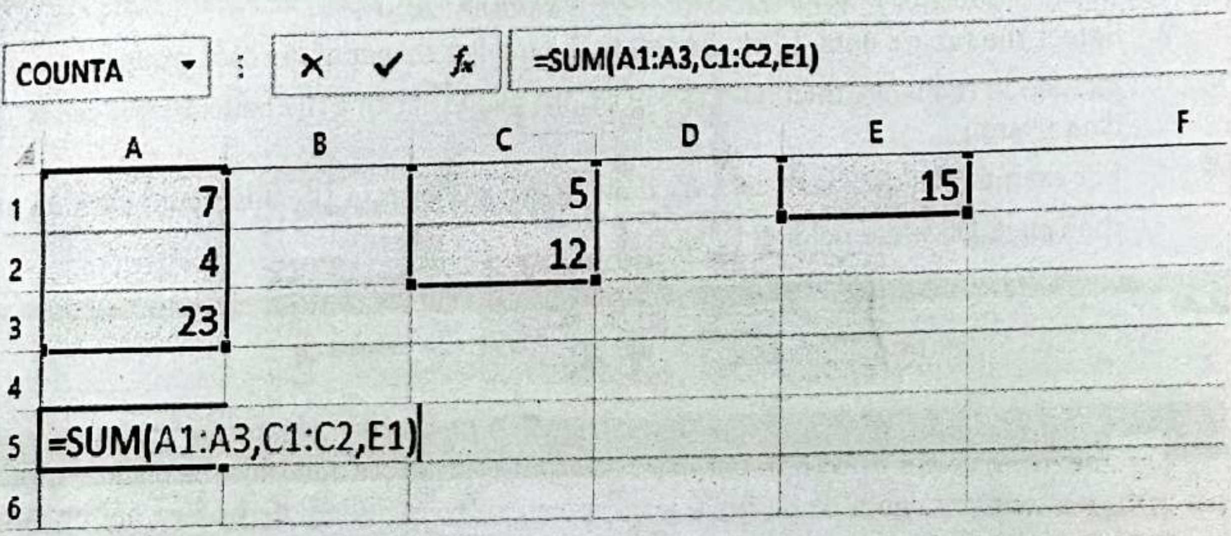
For example, the function =AVERAGE(B1:B9) would calculate the average of the values in the cell range B1:B9. This function contains only one argument.



=AVERAGE(B1:B9)

	A		C
1		5	
2		8	
3		9	
4		7	
5		5	
6		1	
7		3	
8		2	
9		7	
10		=AVERAGE(B1:B9)	
11			

Multiple arguments must be separated by a comma. For example, the function =SUM(A1:A3, C1:C2, E1) will add the values of all the cells in the three arguments.



=SUM(A1:A3,C1:C2,E1)

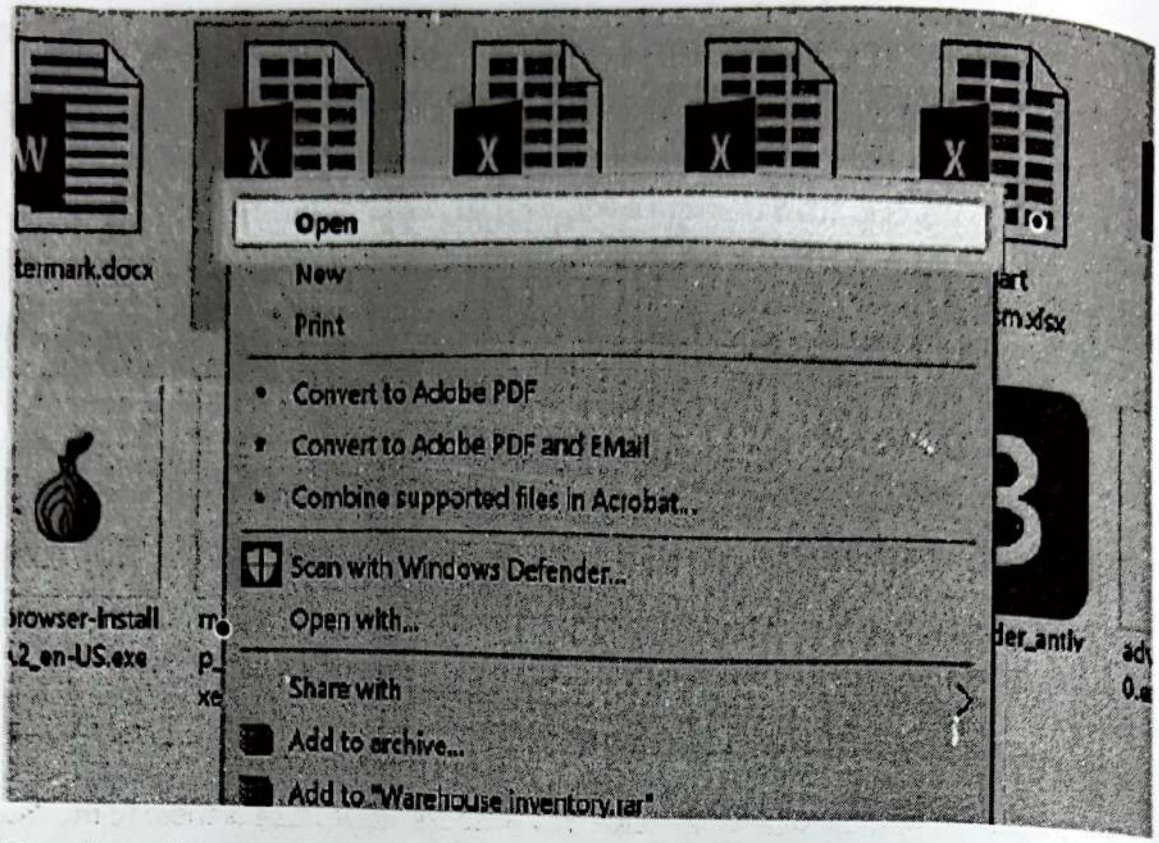
	A	B	C	D	E	F
1	7		5		15	
2	4		12			
3	23					
4						
5	=SUM(A1:A3,C1:C2,E1)					
6						

8.1 TABLES IN EXCEL

8.1.1 Creating Table

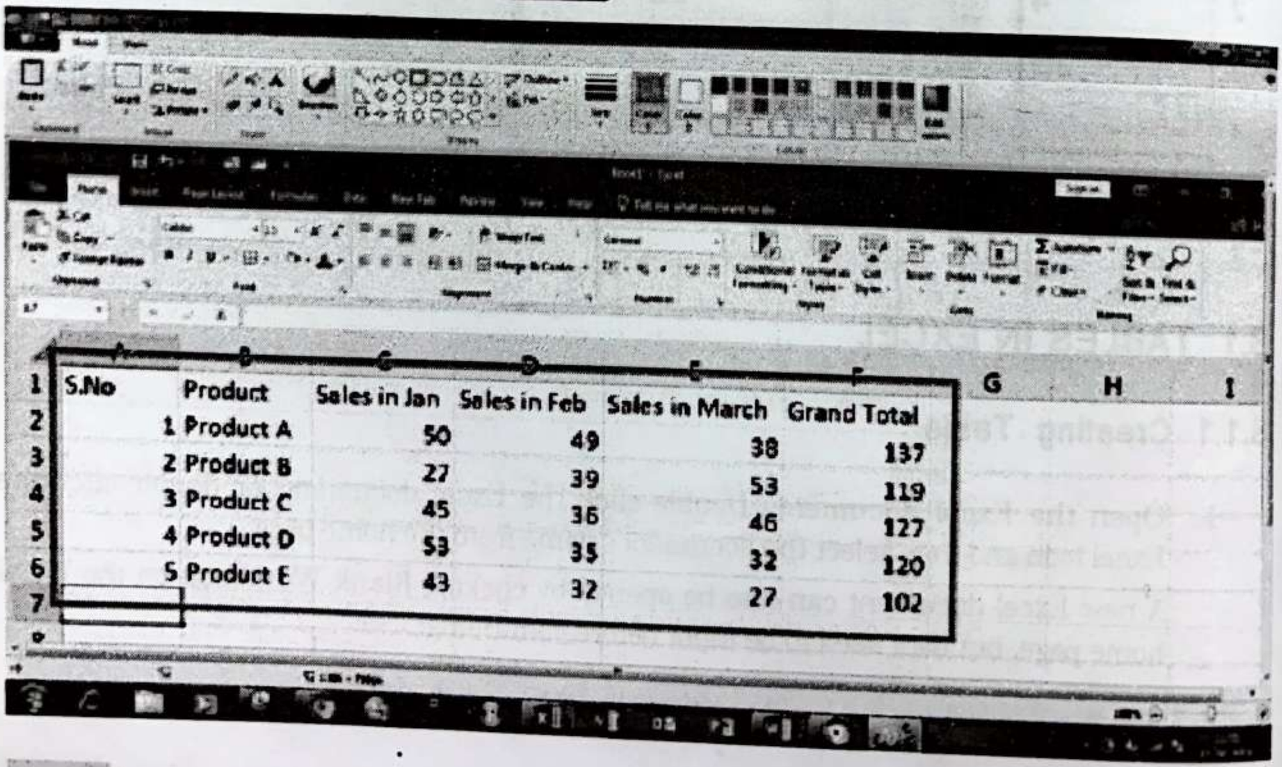
1. Open the Excel document. Double-click the Excel document, or double-click the Excel icon and then select the document's name from the home page.

   A new Excel document can also be opened by clicking **Blank Workbook** on the Excel home page, but data need to be input before continuing.


termark.docx
Open
New
Print
Convert to Adobe PDF
Convert to Adobe PDF and EMail
Combine supported files in Acrobat...
Scan with Windows Defender...
Open with...
Share with
Add to archive...
Add to "Warehouse inventory.rar"
browser-Install
2_en-US.exe
art
m.xlsx
der_antiv

2. Select the table's data. Click the cell in the top-left corner of the data group onewant to include in the table, then hold down ⇧Shift while clicking the bottom-right cell in the data group.

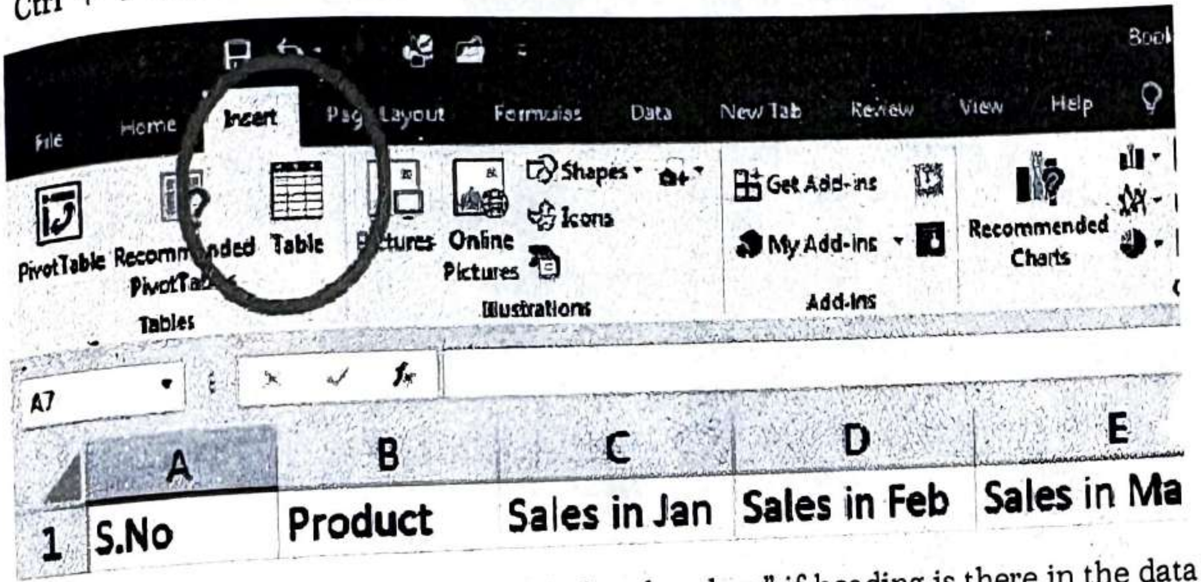
   For example : if data is in cells A1 down to A5 and over to D5, one would click A1 and then click D5 while holding ⇧Shift



S.No	Product	Sales in Jan	Sales in Feb	Sales in March	Grand Total
1	Product A	50	49	38	137
2	Product B	27	39	53	119
3	Product C	45	36	46	127
4	Product D	53	35	32	120
5	Product E	43	32	27	102

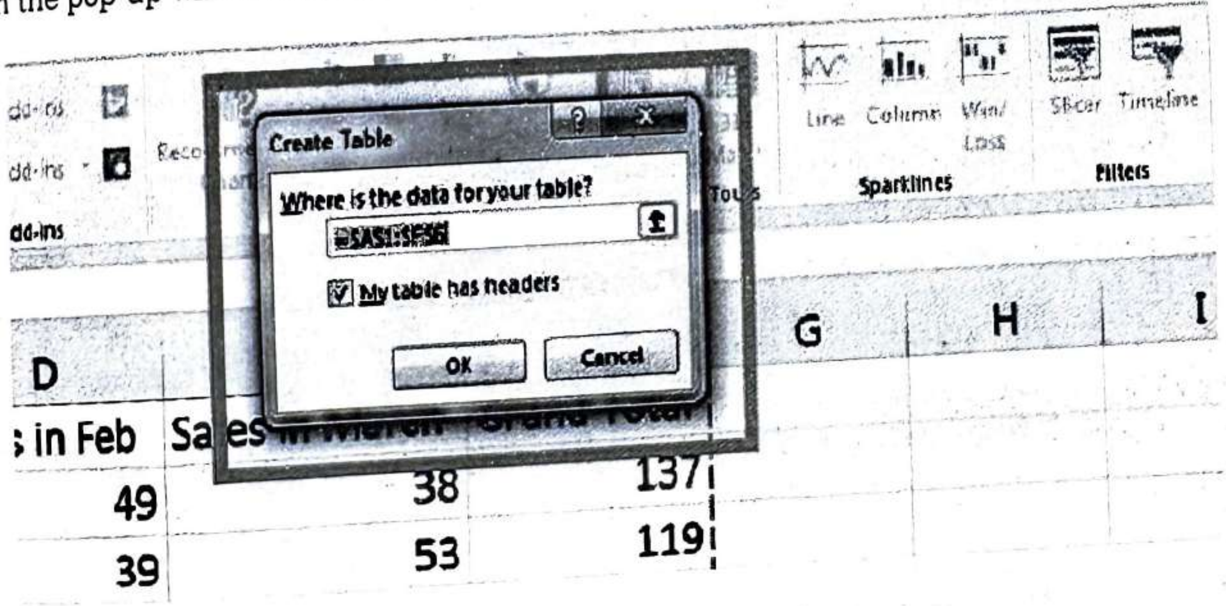
3. Select the data and click the **Insert** tab. It's a tab in the green ribbon at the top of the Excel window. Doing so will display the **Insert** toolbar below the green ribbon. Then Click **Table**. This option is in the "Tables" section of the toolbar. Clicking it brings up a pop-up window.

Ctrl + T can also be used to insert table as a short cut method


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
PivotTable
Recommended PivotTables
Table
Tables
Pictures
Online Pictures
Shapes
Icons
Illustrations
Get Add-ins
My Add-ins
Add-ins
Recommended Charts
A7
A
B
C
D
E

	A	B	C	D	E
1	S.No	Product	Sales in Jan	Sales in Feb	Sales in Ma

4. In the pop-up window select "My table has headers" if heading is there in the data file


Add-ins
Line
Column
Win/Loss
Sparklines
Slicer
Timeline
Filters
D
G
H
I
OK
Cancel

Create Table

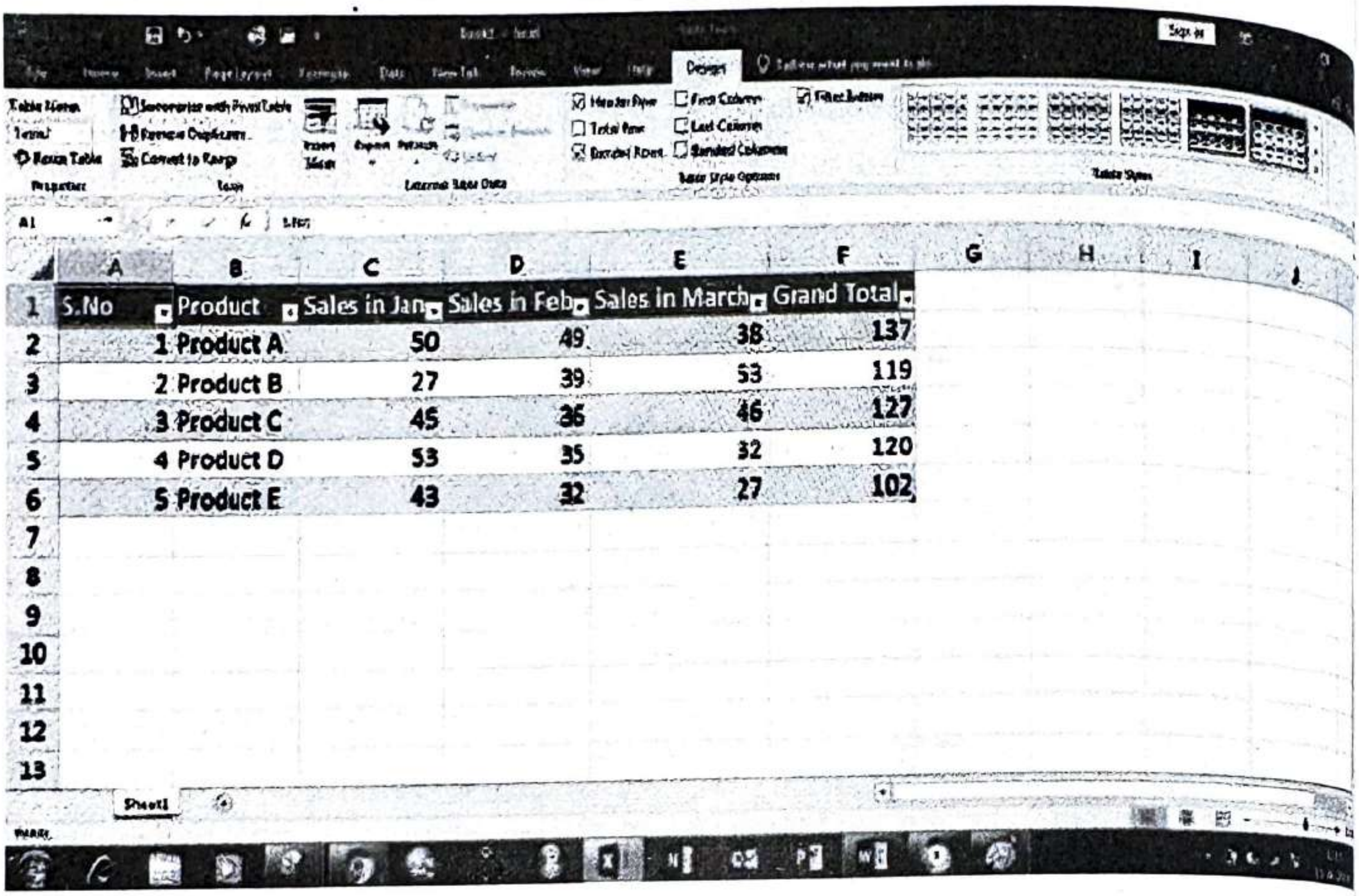
Where is the data for your table?

=$A$1:$F$6

☑ My table has headers

D	E	F
s in Feb	Sales in March	Grand Total
49	38	137
39	53	119

5. The final table will look like shown below :



S.No	Product	Sales in Jan	Sales in Feb	Sales in March	Grand Total
1	Product A	50	49	38	137
2	Product B	27	39	53	119
3	Product C	45	36	46	127
4	Product D	53	35	32	120
5	Product E	43	32	27	102

8.1.2 Formatting Table Design

1. Click the Design tab. It's in the green ribbon near the top of the Excel window. This wil open a toolbar for the table's design directly below the green ribbon.

   If this tab is not seen, click the table to prompt it to appear.

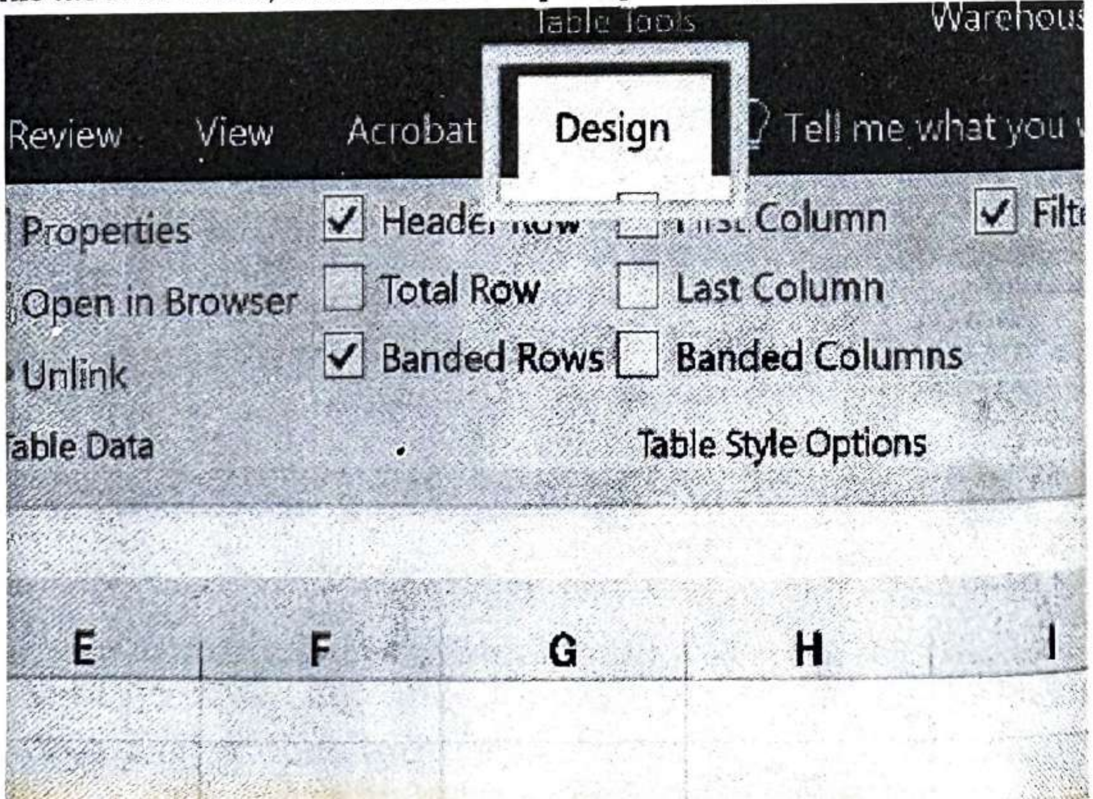


Table Tools
Warehous
Review
View
Acrobat
Design
Tell me what you
Properties
Open in Browser
Unlink
able Data
Table Style Options
E
F
G
H
I

☑ Header Row ☐ First Column ☑ Filt

☐ Total Row ☐ Last Column

☑ Banded Rows ☐ Banded Columns

2. In the Design tab, the various commands are: Properties, Tools, External Table Data, Table Style Options, Table Styles and these are discussed are further.

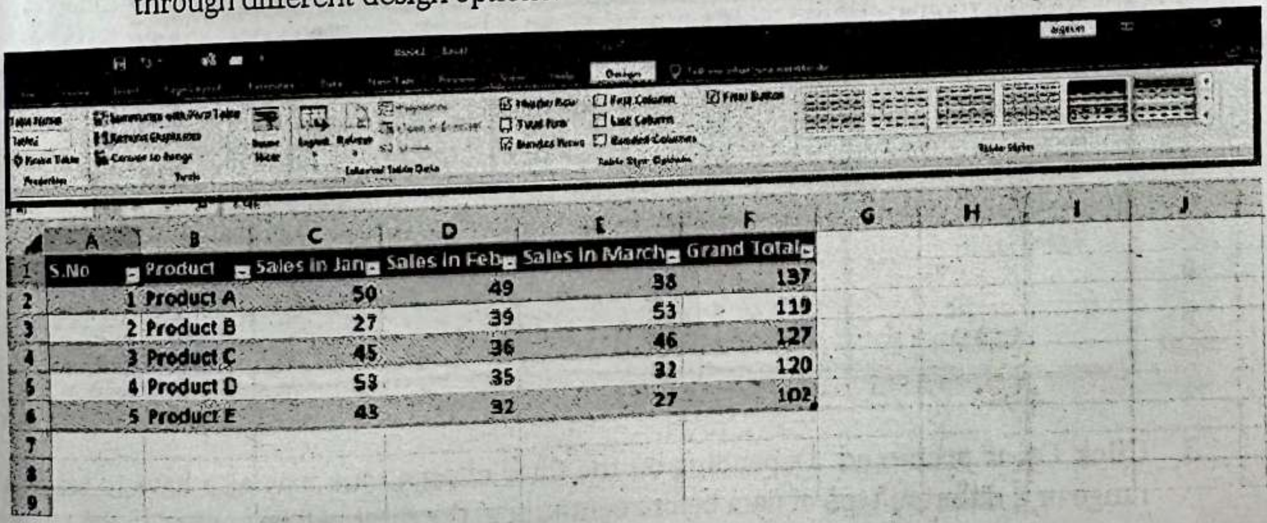
(a) **Properties** : In this the name of the table can be changed by using Table Name command. If more columns or rows are need to be added the Resize Table command will help.

(b) **Table Style Options** : In the "Table Style Options" section of the toolbar, check or uncheck any of the following boxes:

- **Header Row** - Checking this box places column names in the top cell of the data group. Uncheck this box to remove headers
- **Total Row** - When enabled, this option adds a row at the bottom of the table that displays the total value of the right-most column
- **Banded Rows** - Check this box to color in alternating rows or uncheck it to leave all rows in the table the same color.
- **First Column and Last Column** - When enabled, these options make the headers and data in the first and/or last columns bold.
- **Banded Columns** - Check this box to color in alternating columns or uncheck it to leave all columns in the table the same color.
- **Filter Button** - When checked, this box places a drop-down box next to each header in the table that allows one to change the data displayed in that column.

(c) **Table Styles** : Select a design scheme. Click one of the colored boxes in the "Table Styles" section of the Design toolbar to apply the color and design to the table.

One can click the downward-facing arrow to the right of the colored boxes to scroll through different design options.

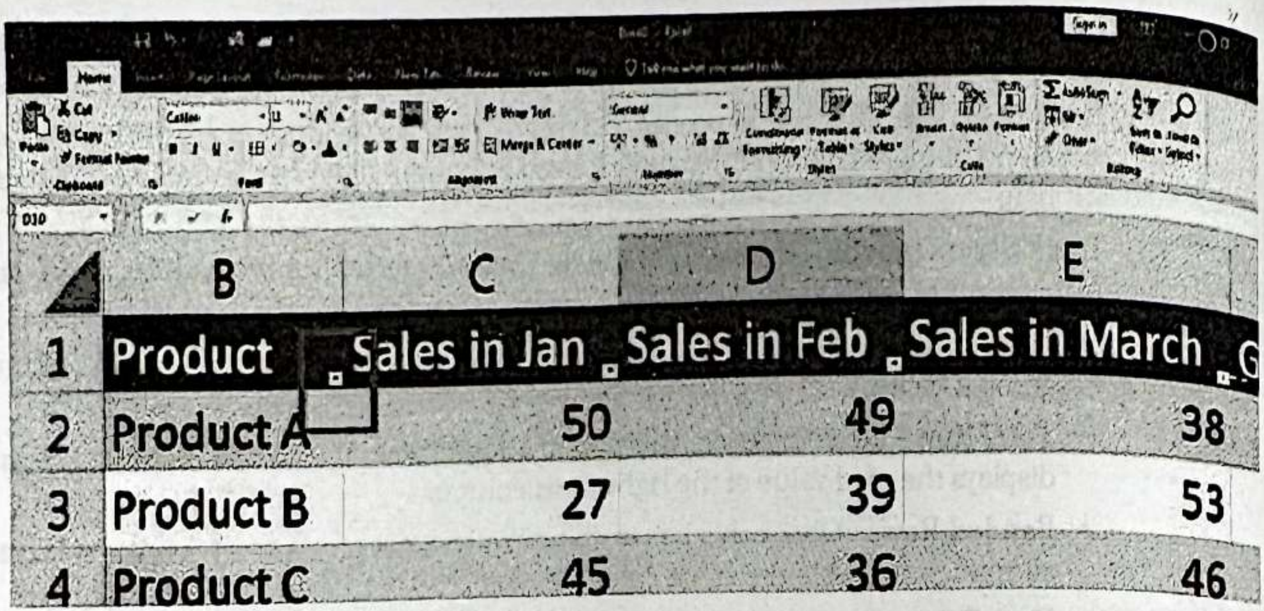


S.No	Product	Sales in Jan	Sales in Feb	Sales in March	Grand Total
1	Product A	50	49	38	137
2	Product B	27	39	53	119
3	Product C	45	36	46	127
4	Product D	53	35	32	120
5	Product E	43	32	27	102

8.1.3 Filtering Table data

1. Open the filter menu. Click the drop-down arrow to the right of the header for the column whose data is to be filtered. A drop-down menu will appear.

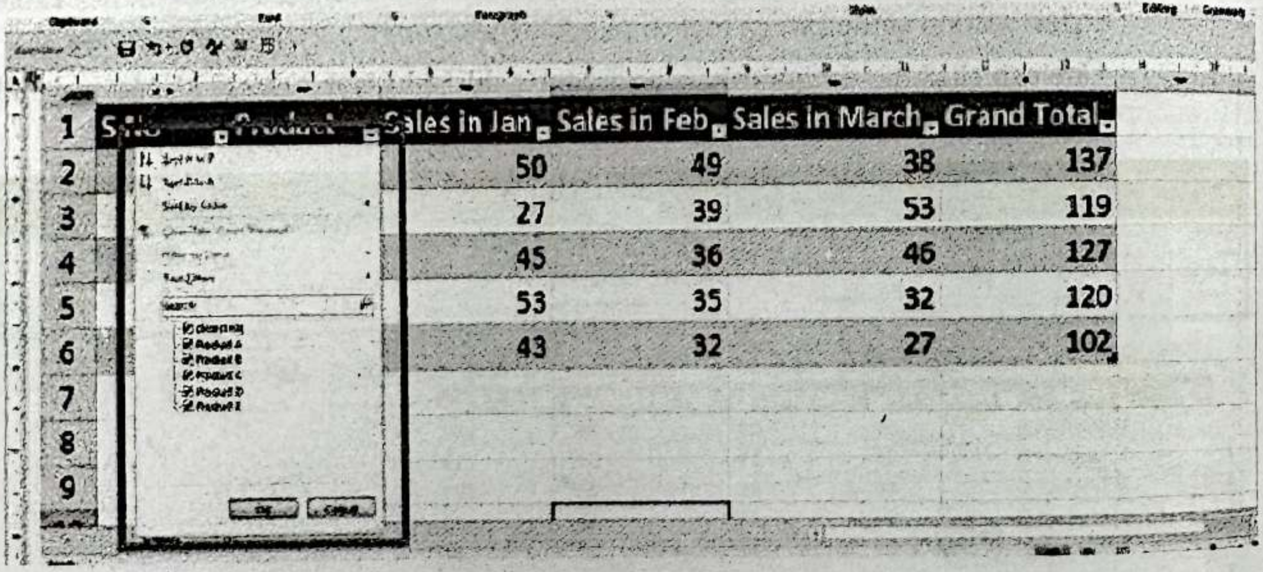
   In order to do this, both the "Header Row" and the "Filter" boxes checked in the "Table Style Options" section of the Design tab.



Product	Sales in Jan	Sales in Feb	Sales in March
Product A	50	49	38
Product B	27	39	53
Product C	45	36	46

2. Select a filter. Click one of the following options in the drop-down menu:
   - Sort Smallest to Largest
   - Sort Largest to Smallest

   There are additional options such as Sort by Color or Number Filters depending on the data. If so, one can select one of these options and then click a filter in the pop-out menu.



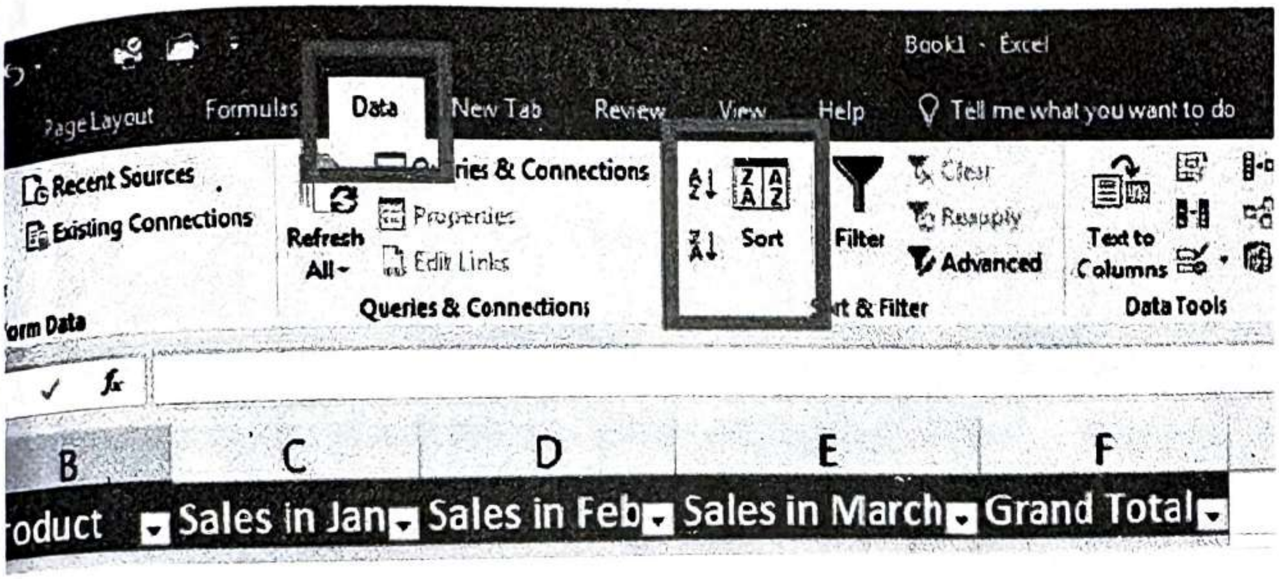
Sales in Jan	Sales in Feb	Sales in March	Grand Total
50	49	38	137
27	39	53	119
45	36	46	127
53	35	32	120
43	32	27	102

3. Click OK if prompted. Depending on the filter chosen, one may also have to select a range or a different type of data before continuing. the filter will be applied to the table.

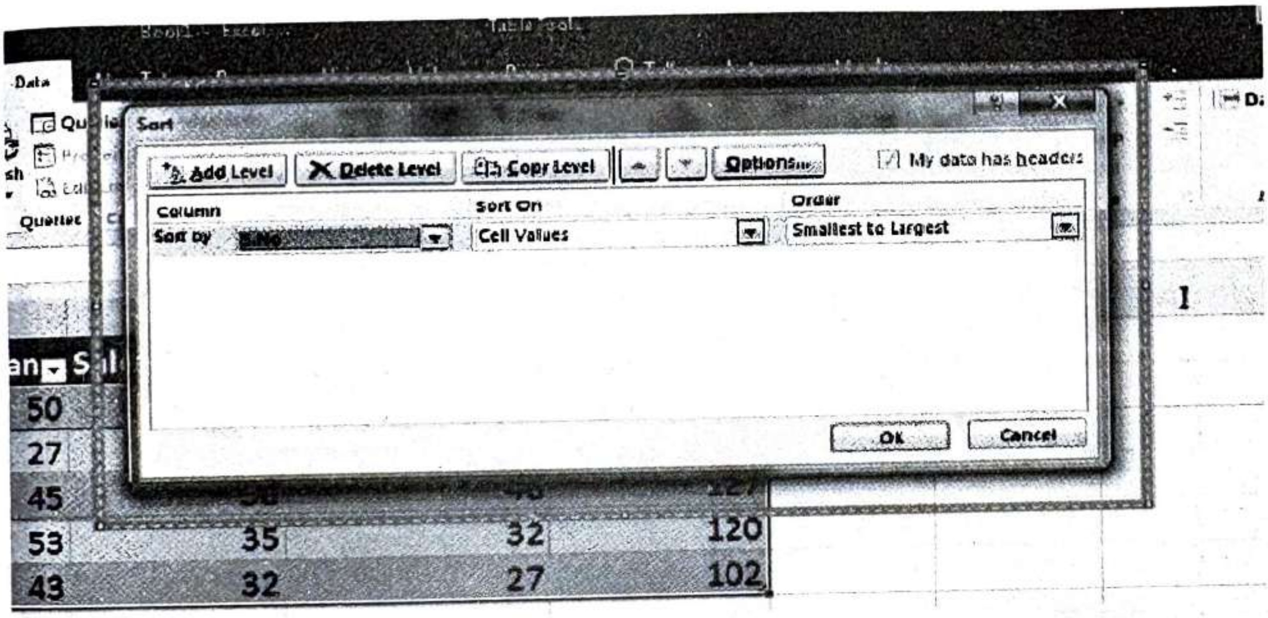
8.1.4 Sorting Table data

1. Select all the cells in the list. This is the safest approach to sorting. In most cases, one can select one cell and Excel will correctly detect the rest of the list -- but it's not 100% certain. Some of the data may be missed.

2. On the Excel Ribbon, click the Data tab.
3. In the Sort & Filter group, click the Sort button.


Book1 - Excel
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell me what you want to do
Recent Sources
Existing Connections
Refresh All
Queries & Connections
Properties
Edit Links
Queries & Connections
Sort
Filter
Clear
Reapply
Advanced
Sort & Filter
Text to Columns
Data Tools
orm Data
B
C
D
E
F
oduct
Sales in Jan
Sales in Feb
Sales in March
Grand Total

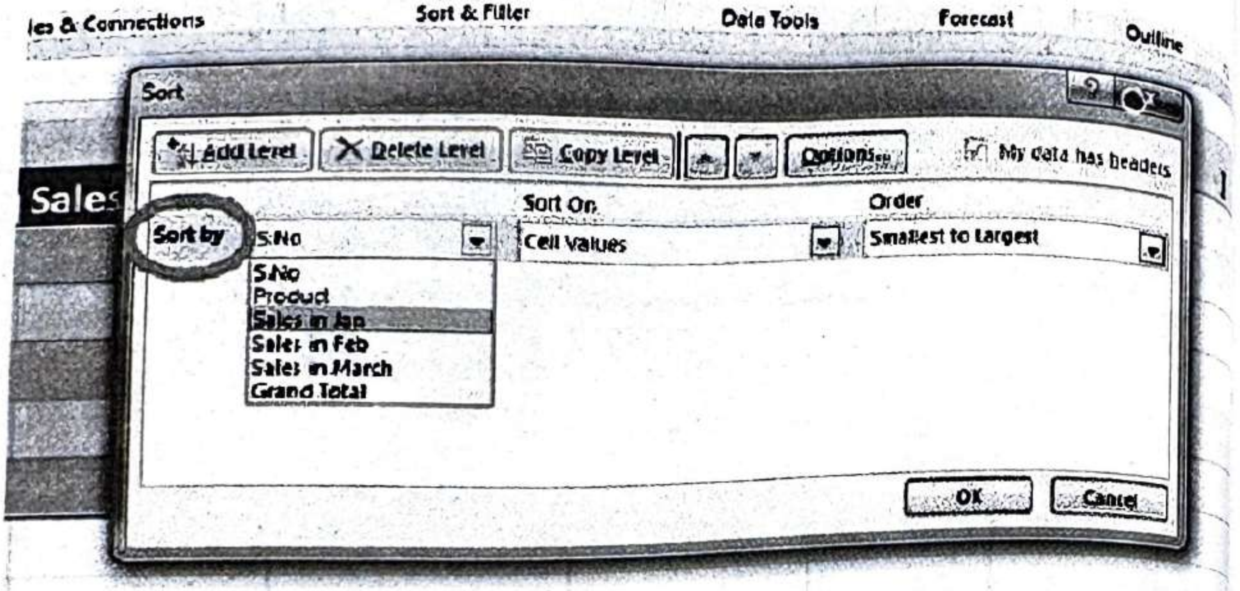
4. A pop-up window will appear showing Column, Sort on, Order


Sort
Add Level
Delete Level
Copy Level
Options...
OK
Cancel
50
27
45
53
35
32
120
43
32
27
102

☑ My data has headers

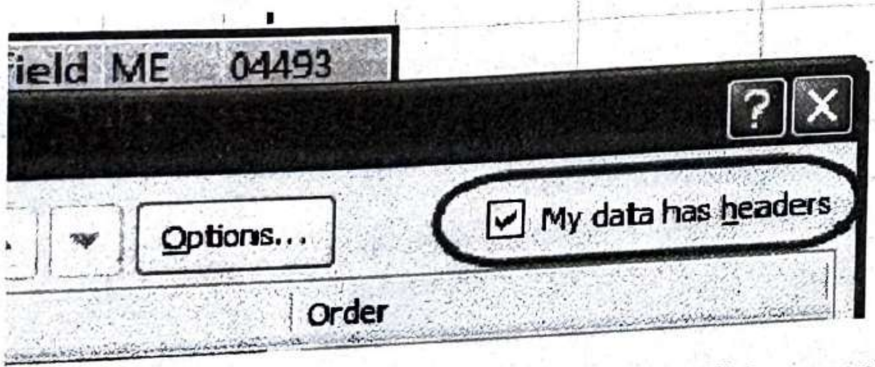
Column	Sort On	Order
Sort by	Cell Values	Smallest to Largest

5. From the Sort by dropdown, select the first column to be sorted. In this example, "Sales in Jan" will be the first column sorted.


les & Connections
Sort & Filter
Data Tools
Forecast
Outline
Sort
Add Level
Delete Level
Copy Level
Options...
My data has headers
Sales
S.No
Product
Sales in Jan
Sales in Feb
Sales in March
Grand Total
OK
Cancel

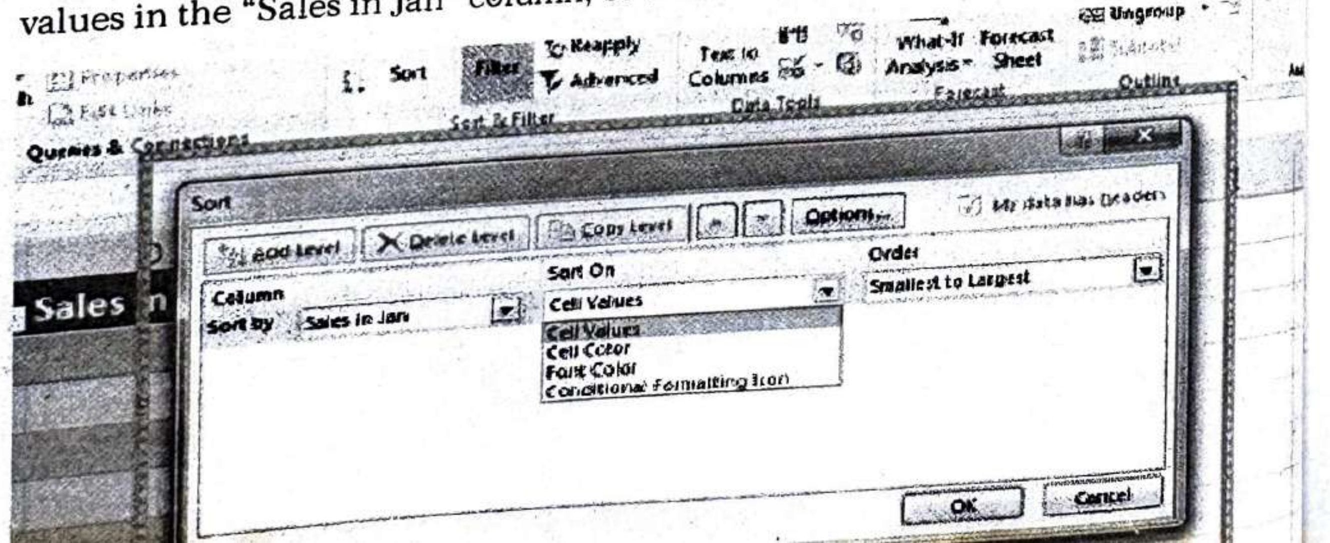
Sort by: S.No
Sort On: Cell Values
Order: Smallest to Largest

Note: If the dropdown is showing Column letters instead of headings, add a check mark t
My data has headers.


ield ME 04493
Options...
Order

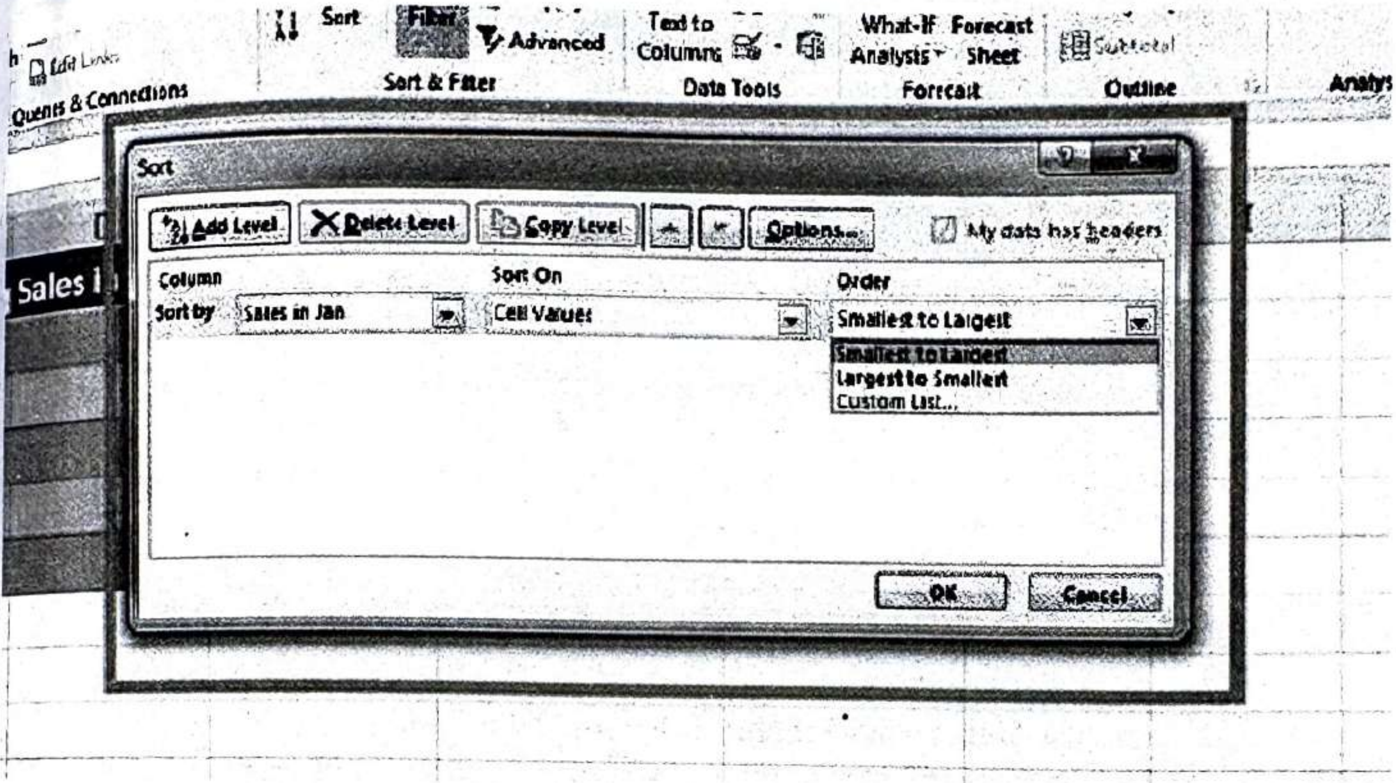
☑ My data has headers

6. From the Sort On drop down, select the required option. This example is sorting on the values in the "Sales in Jan" column, so leave the default setting of Values.


Properties
Edit Links
Queries & Connections
Sort
Filter
Reapply
Advanced
Sort & Filter
Text to Columns
Data Tools
What-If Analysis
Forecast Sheet
Forecast
Ungroup
Subtotal
Outline
Sort
Add Level
Delete Level
Copy Level
Options...
My data has headers
Sales in
Cell Values
Cell Color
Font Color
Conditional Formatting Icon
OK
Cancel

Column Sort by: Sales in Jan
Sort On: Cell Values
Order: Smallest to Largest

7. Next, from the Order drop down, select one of the options. The list of Order options will depend on what is selected in the Sort On column. Because values are selected in this example and the Order options are Smallest to Largest, Largest to Smallest and Custom List, Smallest to Largest will be selected for further analysis.

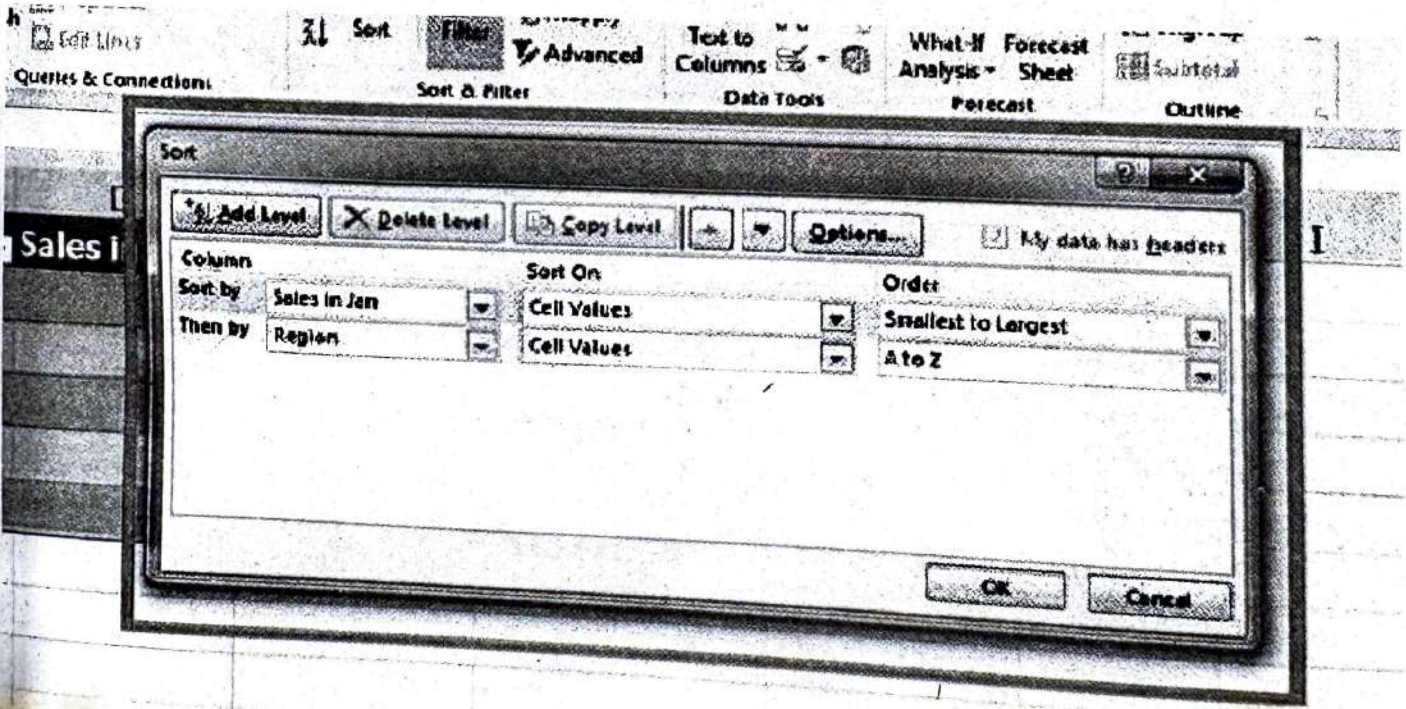

Edit Links
Queries & Connections
Sort
Filter
Advanced
Sort & Filter
Text to Columns
Data Tools
What-If Analysis
Forecast Sheet
Forecast
Subtotal
Outline
Analysis
Sales i
Sort
Add Level
Delete Level
Copy Level
Options...
My data has headers
Column
Sort On
Order
OK
Cancel

Sort by: Sales in Jan | Cell Values | Smallest to Largest

Smallest to Largest
Largest to Smallest
Custom List...

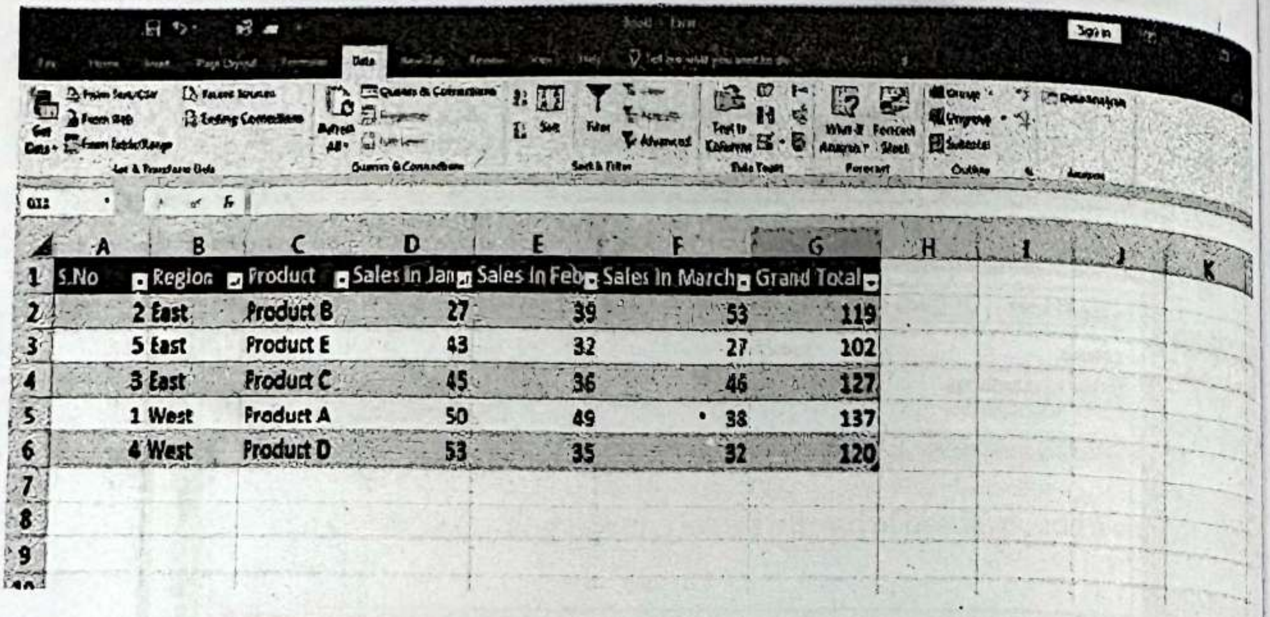
8. If one is sorting on multiple columns, click the Add Level button, to add the next level, and select options from its drop-down boxes.

This examplehave selected "Sales in Jan", "Region" as the sort fields, and all are sorted on Values. Because the "Sales in Jan" column contains only numbers, its Order options are slightly different from the text column options.


Edit Links
Queries & Connections
Sort
Filter
Advanced
Sort & Filter
Text to Columns
Data Tools
What-If Analysis
Forecast Sheet
Forecast
Subtotal
Outline
Analysis
Sales i
Sort
Add Level
Delete Level
Copy Level
Options...
My data has headers
Column
Sort On
Order
OK
Cancel

Sort by: Sales in Jan | Cell Values | Smallest to Largest
Then by: Region | Cell Values | A to Z

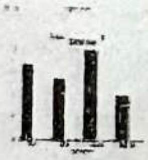
9. After all the Sort levels and their options have been selected, click OK and the final output screen is shown below.

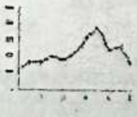


S.No	Region	Product	Sales In Jan	Sales In Feb	Sales In March	Grand Total
2	East	Product B	27	39	53	119
5	East	Product E	43	32	27	102
3	East	Product C	45	36	46	127
1	West	Product A	50	49	38	137
4	West	Product D	53	35	32	120

8.2 CHARTS AND GRAPHS

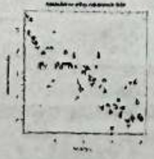
A chart, also known as graph, is a graphical representation of numeric data where the data is represented by symbols such as bars, columns, lines, slices, and so on. Microsoft Excel allows to create a great lot of different graph types such as Column chart, Bar chart, Line chart, Pie chart, Area chart, Bubble chart, Stock, Surface, Radar charts, Pivot Chart etc. Some examples are shown in Figure below :


Bar chart


Line chart

Pie chart

Area chart

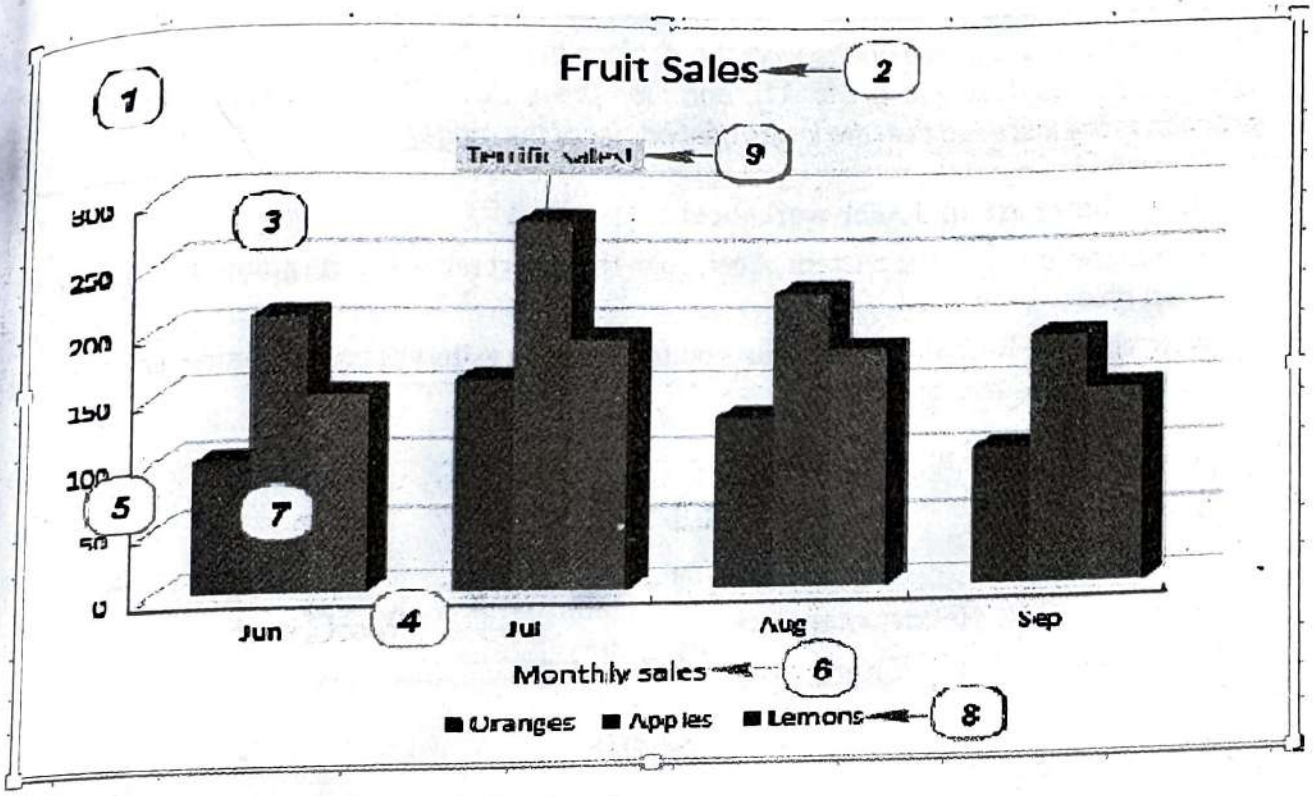

Scatter plot

Bubble chart

Radar chart

Excel charts have a handful of elements. Some of these elements are displayed by default, others can be added and modified manually as needed.

1. Chart area
2. Chart title
3. Plot area
4. Horizontal (category) axis
5. Vertical (value) axis
6. Axis title
7. Data points of the data series
8. Chart legend
9. Data label

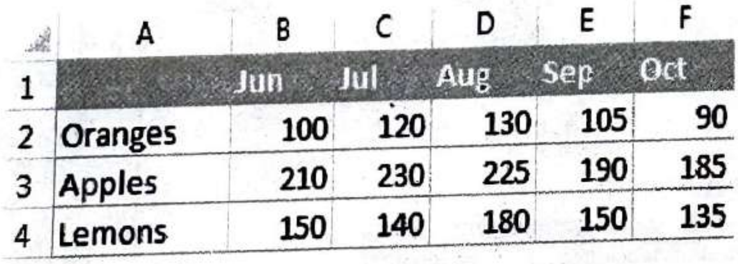


8.2.1 How to make a graph in Excel

Graphs can be created in EXCEL from a variety of chart types to present the data in the most meaningful way. Combination charts can also be prepared by using several chart types.

To create a chart in Excel, start by entering the numeric data on a worksheet, and then continue with the following steps.

1. Select data to include in the chart



	A	B	C	D	E	F
1		Jun	Jul	Aug	Sep	Oct
2	Oranges	100	120	130	105	90
3	Apples	210	230	225	190	185
4	Lemons	150	140	180	150	135

Assuming that the data shown above has already been prepared, select all the data to be included in Excel graph. Select the column headings they are needto be appeared either in the chart legend or axis labels.

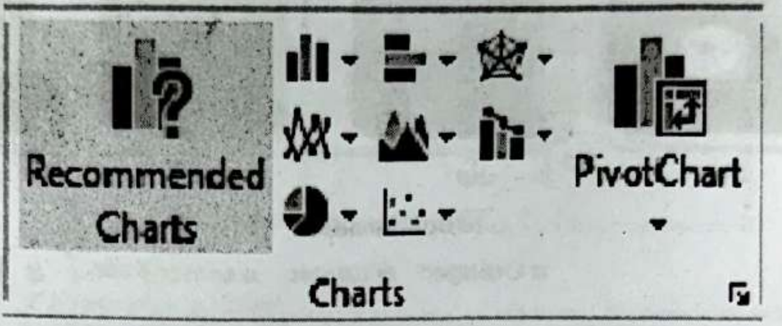
- If one wants to make a chart based on adjacent cells, one can select only one cell, and Excel will automatically include all contiguous cells that contain data.
- To create a graph based on the data in non-adjacent cells, select the first cell or a range of cells, hold down the CTRL key and select other cells or ranges. (Please note, one can plot non-adjacent cells or ranges in a chart only if the selection forms a rectangle).

Tip. To select all used cells on the worksheet, place the cursor in the first cell of the used range (press Ctrl+Home to get to A1), and then press Ctrl + Shift + End to extend the selection to the last used cell (the lower-right corner of the range).

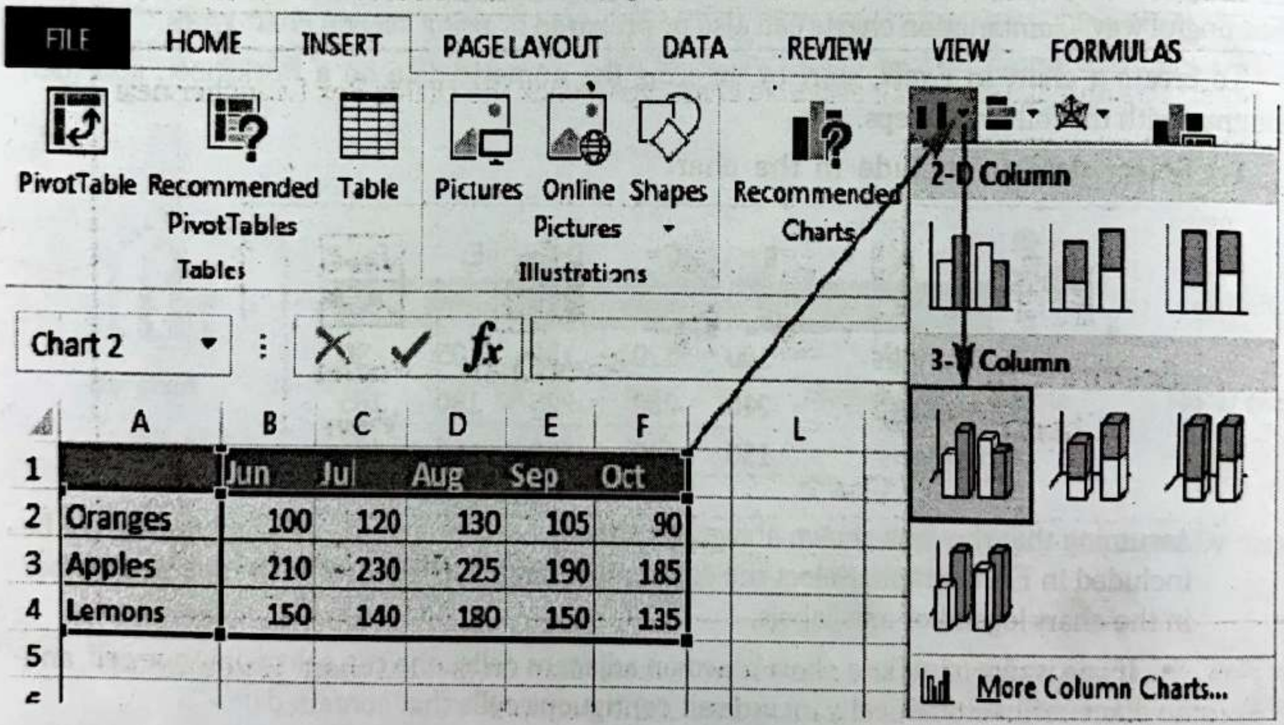
2. Inset the chart in Excel worksheet

To add the graph on the current sheet, go to the Insert tab > Charts group, and click on a chart type to be created.

Now, click the Recommended Charts button to view a gallery of pre-configured graphs that best match the selected data.

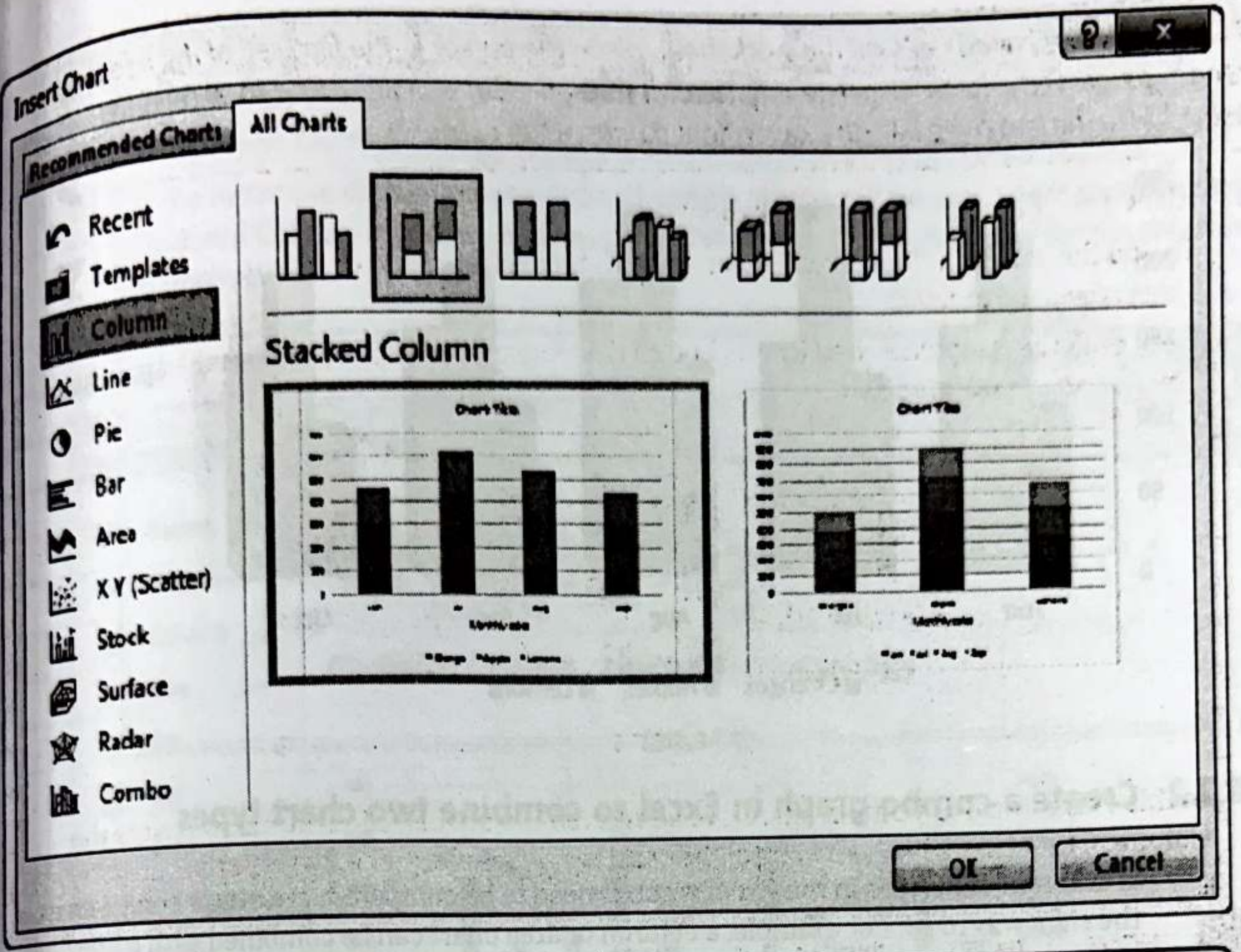

Recommended Charts
PivotChart
Charts

In this example a 3-D Column chart is to be created. To do this, click the arrow next to the Column Chart icon and choose one of the chart sub-types under the 3-D Column category.

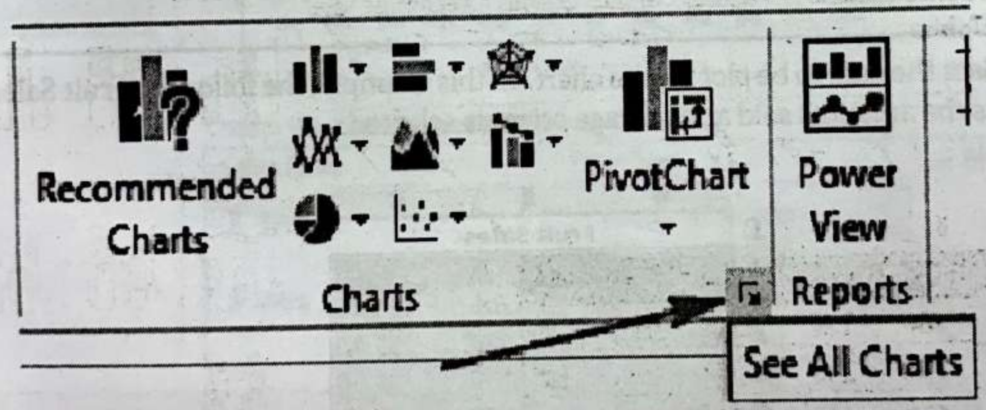

FILE
HOME
INSERT
PAGE LAYOUT
DATA
REVIEW
VIEW
FORMULAS
PivotTable
Recommended PivotTables
Table
Tables
Pictures
Online Pictures
Shapes
Illustrations
Recommended Charts
2-D Column
3-D Column
More Column Charts...
Chart 2
fx

	A	B	C	D	E	F
1		Jun	Jul	Aug	Sep	Oct
2	Oranges	100	120	130	105	90
3	Apples	210	230	225	190	185
4	Lemons	150	140	180	150	135

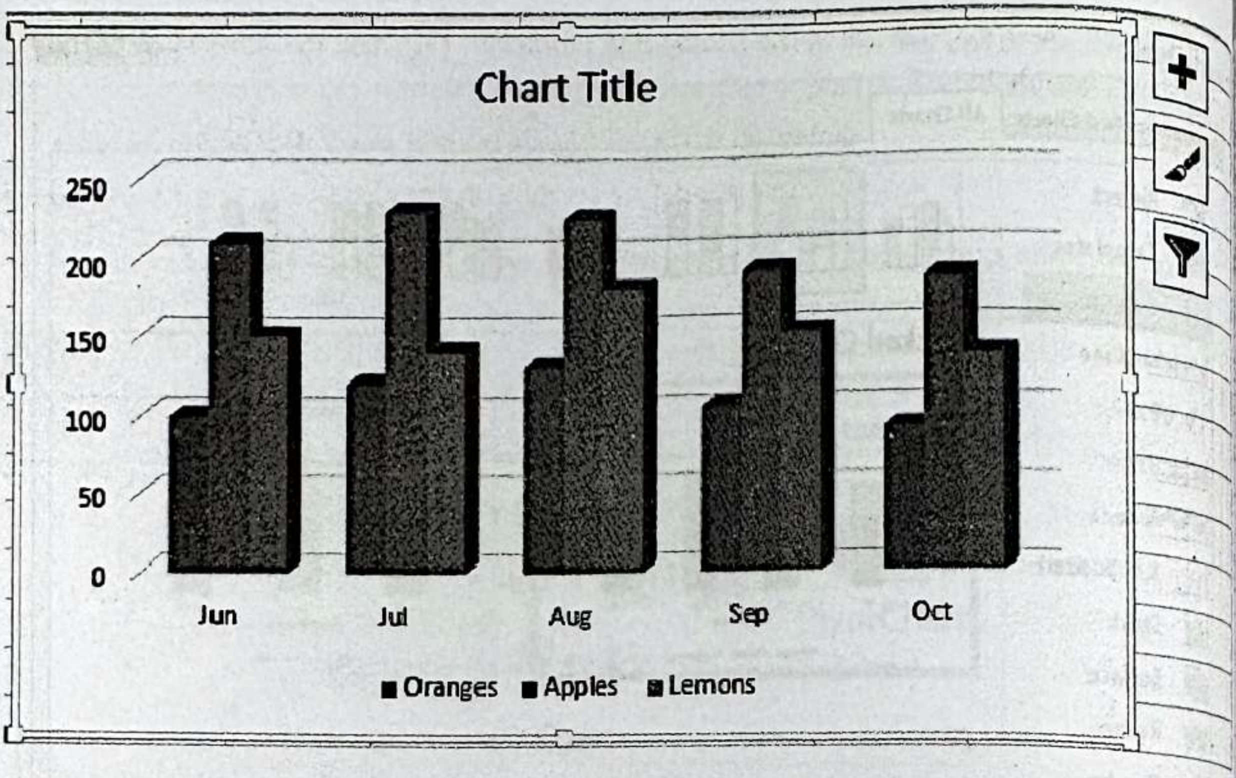
For more chart types, click the More Column Charts… link at the bottom. The Insert Chart dialog window will open, and a list of available column chart sub-types will be seen at the top. Other graph types can also be chosen on the left-hand side of the dialog.


Insert Chart
Recommended Charts
All Charts
Recent
Templates
Column
Line
Pie
Bar
Area
X Y (Scatter)
Stock
Surface
Radar
Combo
Stacked Column
OK
Cancel

Note: To immediately see all available chart types, click the Dialog Box Launcher next to Charts.


Recommended Charts
Charts
PivotChart
Power View
Reports
See All Charts

Now, the graph is placed on the current worksheet as an embedded chart. Here's the 3-D Column chart created by Excel for the data of the example:

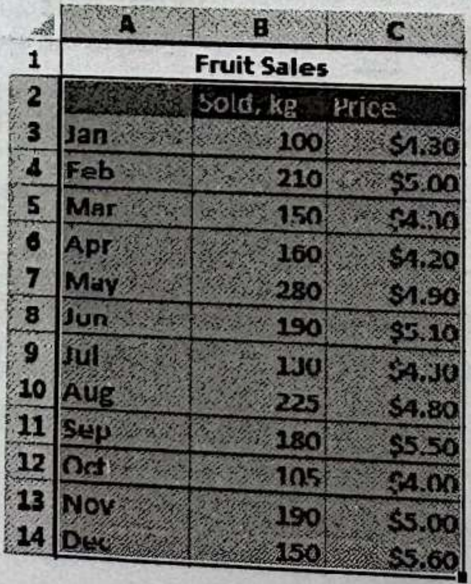


8.2.2 Create a combo graph in Excel to combine two chart types

If different data types in the Excel graph is need to be compared, creating a combo chart is the right way to go. For example, a column or area chart can be combined with a line chart to present dissimilar data, for example an overall revenue and the number of items sold.

NOTE: In Microsoft Excel 2010 and earlier versions, creating a combination chart was a cumbersome task.

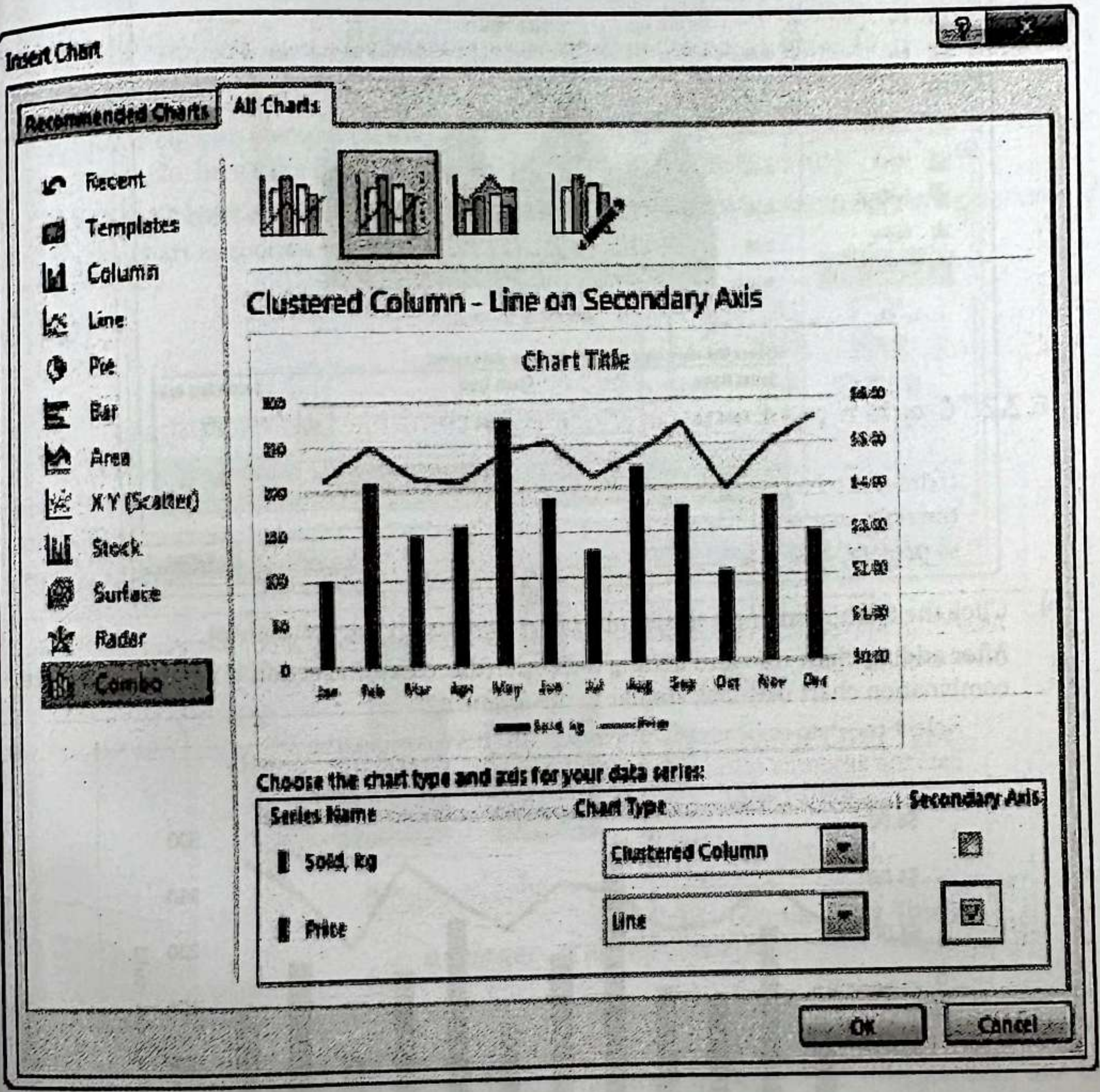
1. Select the data to be plot for the chart. In this example, the following Fruit Sales table that lists the amounts sold and average prices is selected.



	A	B	C
1	Fruit Sales		
2		Sold, kg	Price
3	Jan	100	$4.30
4	Feb	210	$5.00
5	Mar	150	$4.10
6	Apr	160	$4.20
7	May	280	$4.90
8	Jun	190	$5.10
9	Jul	130	$4.30
10	Aug	225	$4.80
11	Sep	180	$5.50
12	Oct	105	$4.00
13	Nov	190	$5.00
14	Dec	150	$5.60

2. On the *Insert* tab, click the *Dialog Box Launcher* ⧉ next to *Charts* to open the *Insert Chart* dialog.
3. In the *Insert Chart* dialog, go to the *All Charts* tab and select the Combo category.

   At the top of the dialog, few pre-defined combo charts will be seen to get started quickly. *Clustered Column and Line on Secondary Axis* graph will be prepared for the data of the example given.

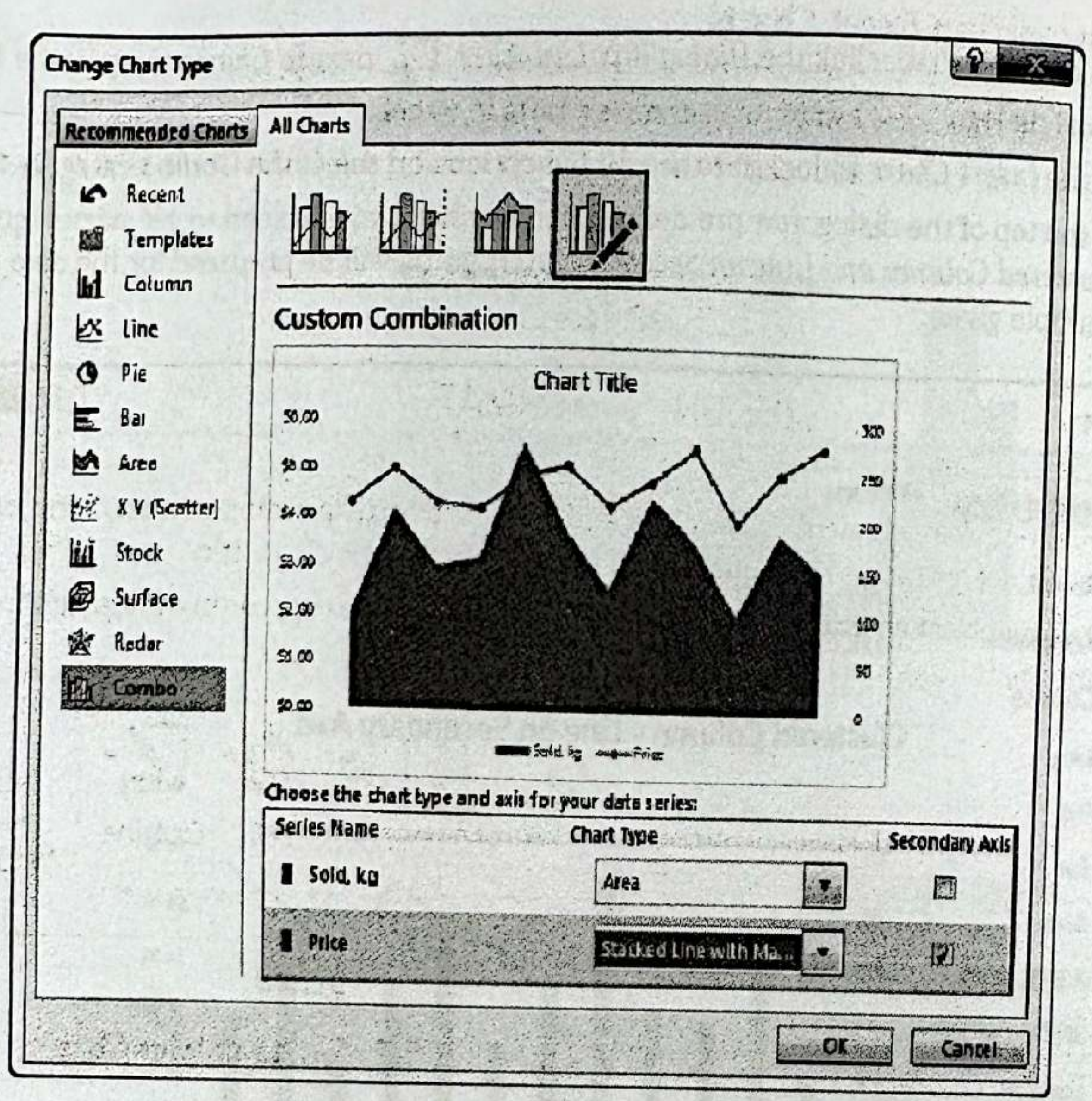

Insert Chart
Recommended Charts
All Charts
Recent
Templates
Column
Line
Pie
Bar
Area
X Y (Scatter)
Stock
Surface
Radar
Combo
Chart Title
0
50
100
150
200
250
300
$0.00
$1.00
$2.00
$3.00
$4.00
$5.00
$6.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Sold, kg
Price
OK
Cancel

Clustered Column - Line on Secondary Axis

Choose the chart type and axis for your data series:

Series Name	Chart Type	Secondary Axis
Sold, kg	Clustered Column	☐
Price	Line	☑

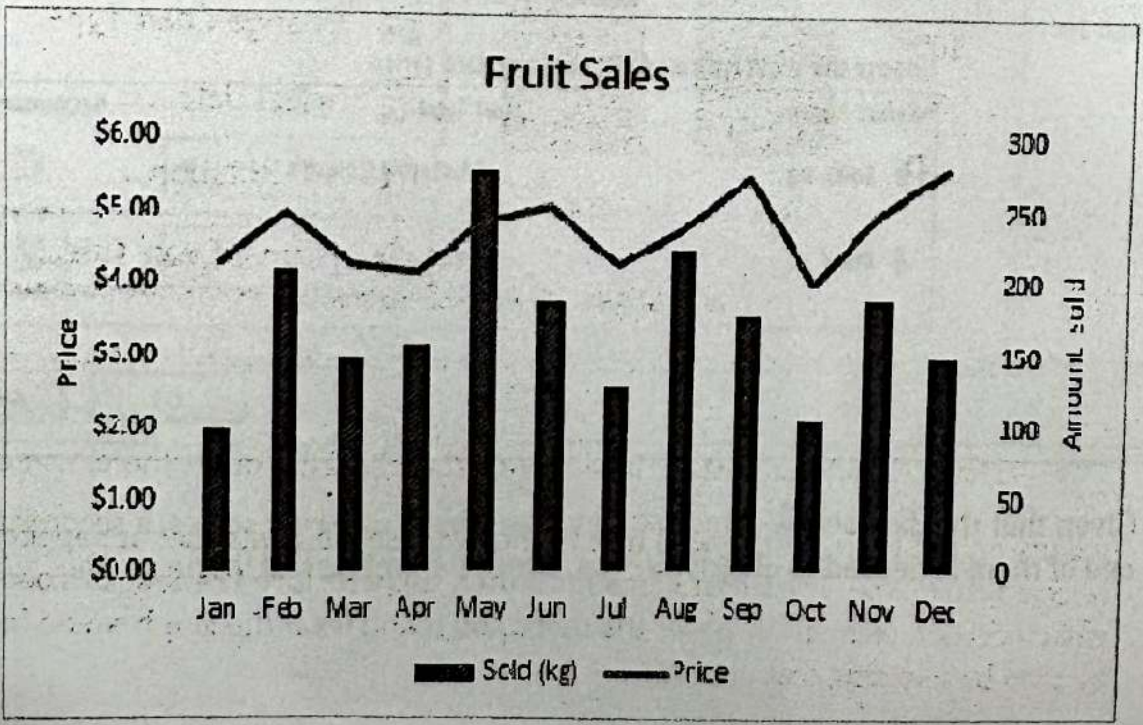
Given that the data series (Amount and Price) have different scales, a secondary axis in one of them is needed to clearly see the values for both series in the graph.


Change Chart Type
Recommended Charts
All Charts
Recent
Templates
Column
Line
Pie
Bar
Area
X Y (Scatter)
Stock
Surface
Radar
Combo
Custom Combination
Chart Title
$5.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
300
250
200
150
100
50
0
Sold, kg
Price
OK
Cancel

Choose the chart type and axis for your data series:

Series Name	Chart Type	Secondary Axis
Sold, kg	Area	☐
Price	Stacked Line with Ma...	☑

4. Click the OK button to get the combo chart inserted in the Excel sheet.
   After adding chart title and adding axis title (discussed in section 8.2.3) the completed combination chart may look similar to the following:



8.2.3 Customizing Excel Charts

Overall, there are 3 ways to customize charts in Excel.

1. Select the chart and look for the needed options on the Chart Tools tabs on the Excel ribbon.

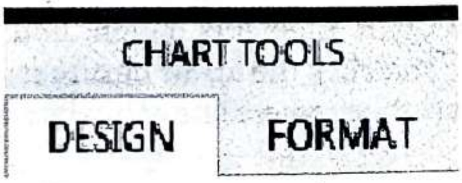
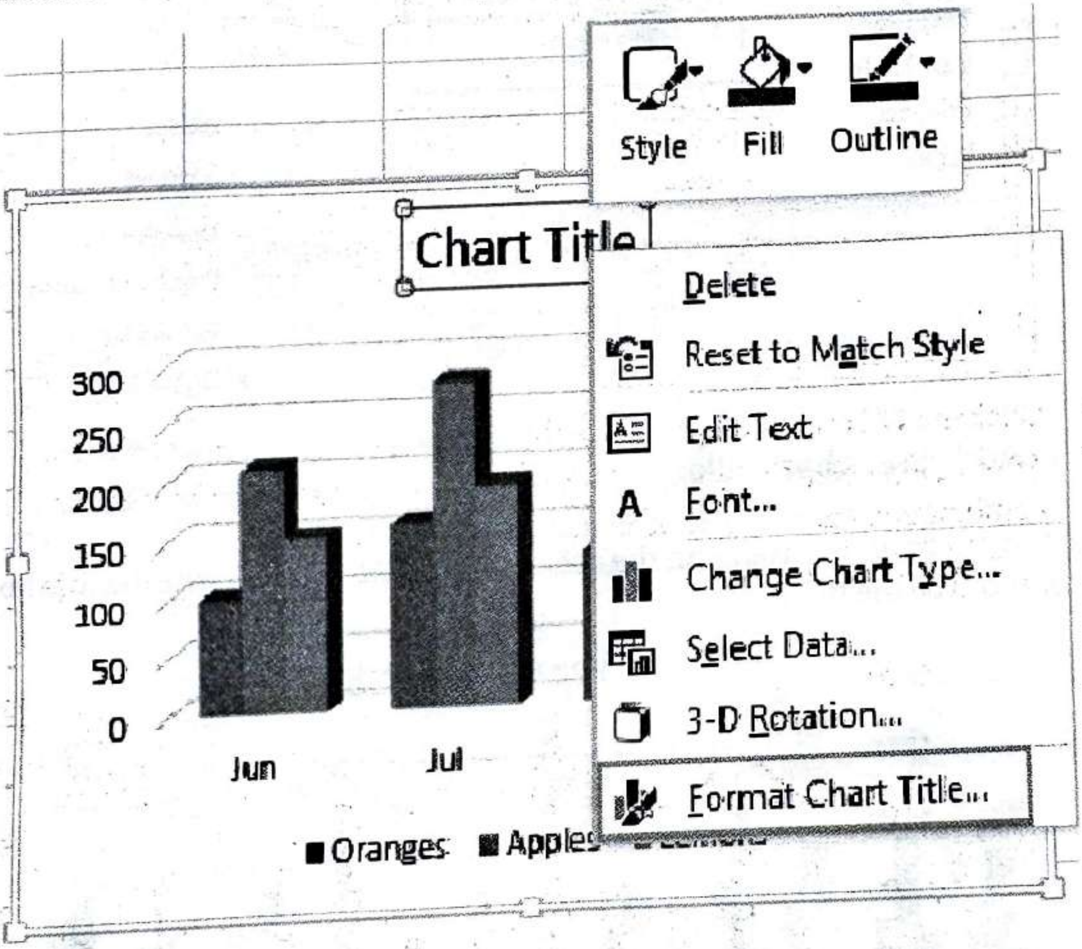


CHART TOOLS
DESIGN
FORMAT

2. Right-click an element on the chart and select the corresponding context menu item. For example, here's the right-click menu for customizing the chart title:
3. Use on-object chart customization buttons. These buttons appear in the top right corner of the chart as soon as oneclick on it.


Style
Fill
Outline
Chart Title
Delete
Reset to Match Style
Edit Text
Font...
Change Chart Type...
Select Data...
3-D Rotation...
Format Chart Title...
300
250
200
150
100
50
0
Jun
Jul
Oranges
Apples

+ **Chart Elements** button. It launches the checklist of all the elements one can modify or add to the graph, and it only shows those elements that are applicable to the selected chart type. The Chart Elements button supports Live Preview, so if one is not sure what a certain element is, hover the mouse on it and what the graph would look like will be seen by selecting that option.

Chart Styles button. It lets quickly change the chart styles and colors.

Chart Filters button. It allows to show or hide data displayed in the chart.

For more options, click the Chart Elements button, find the element to be added or customized in the checklist, and click the arrow next to it. The Format Chart pane will appear on the right of the worksheet, where one can select the required options:

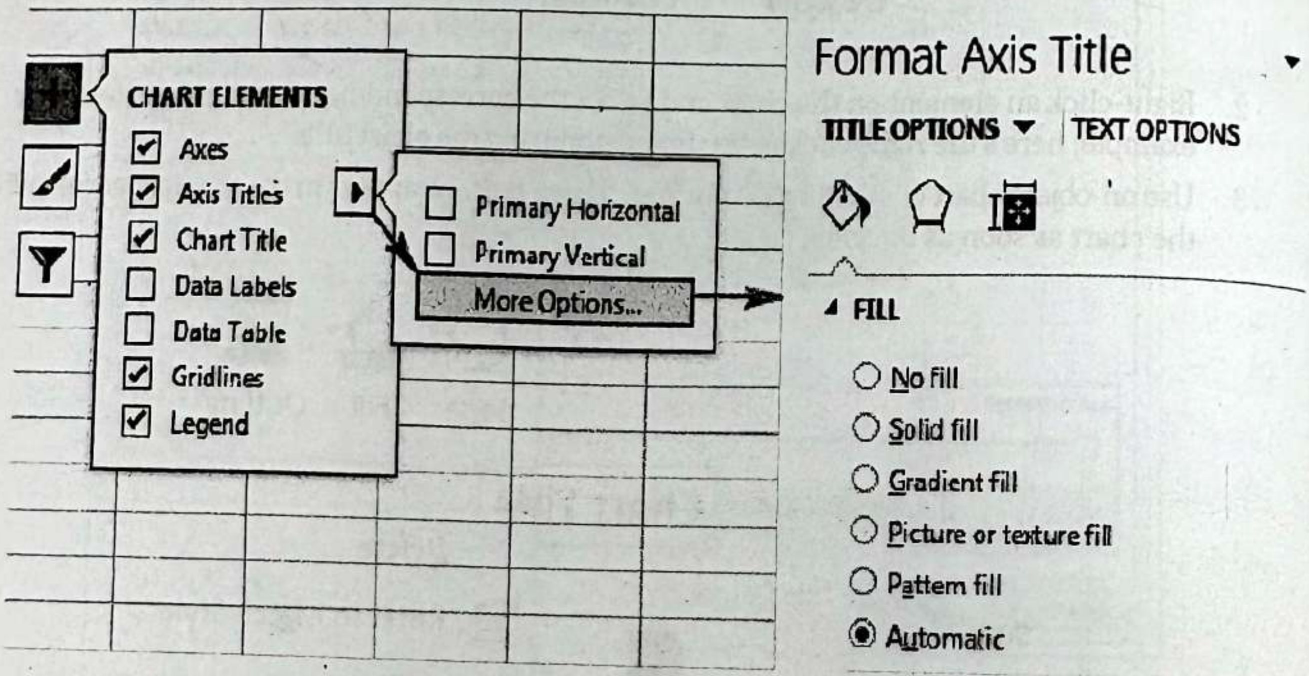


CHART ELEMENTS
- ☑ Axes
- ☑ Axis Titles
- ☑ Chart Title
- ☐ Data Labels
- ☐ Data Table
- ☑ Gridlines
- ☑ Legend

- ☐ Primary Horizontal
- ☐ Primary Vertical
- More Options...

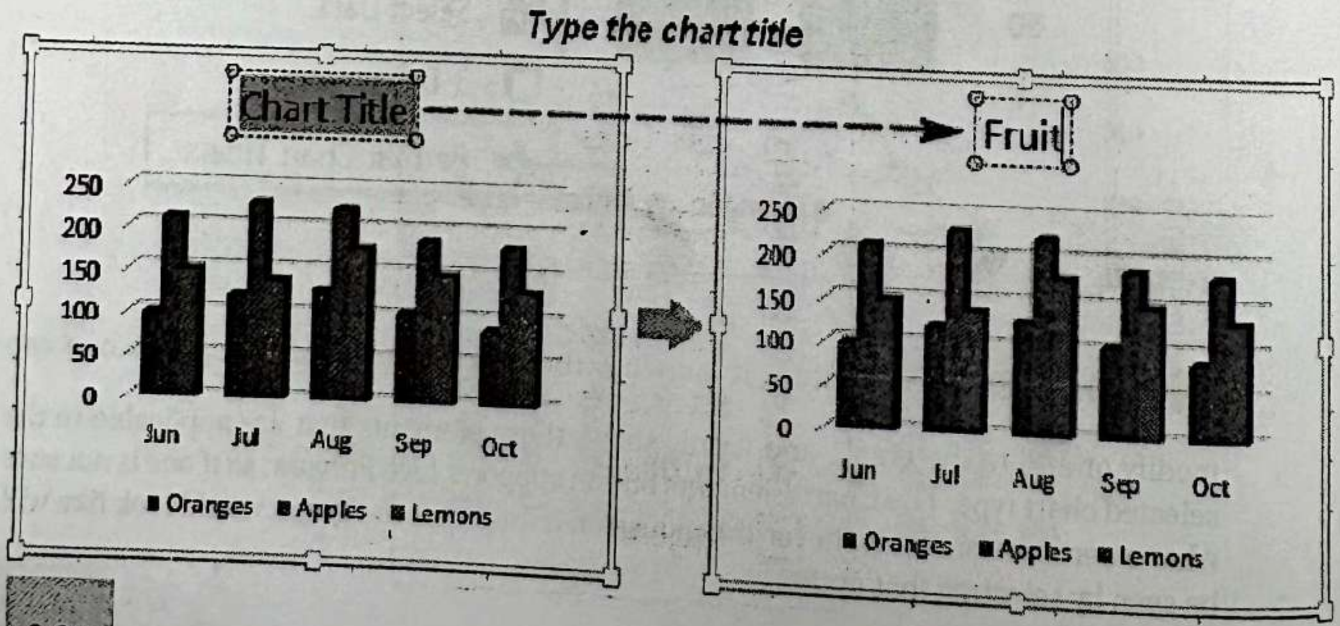
Format Axis Title

TITLE OPTIONS | TEXT OPTIONS

FILL
- ○ No fill
- ○ Solid fill
- ○ Gradient fill
- ○ Picture or texture fill
- ○ Pattern fill
- ● Automatic

8.2.3.1 Add the chart title

A chart is already inserted with the default "*Chart Title*". To change the title text, simply select that box and type the title:



Type the chart title

Chart Title
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
Oranges
Apples
Lemons
Fruit
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
Oranges
Apples
Lemons

If for some reason the title was not added automatically, then click anywhere within the graph for the Chart Tools tabs to appear. Switch to the Design tab and click *Add Chart Element > Chart Title > Above Chart I (or Centered Overlay)*

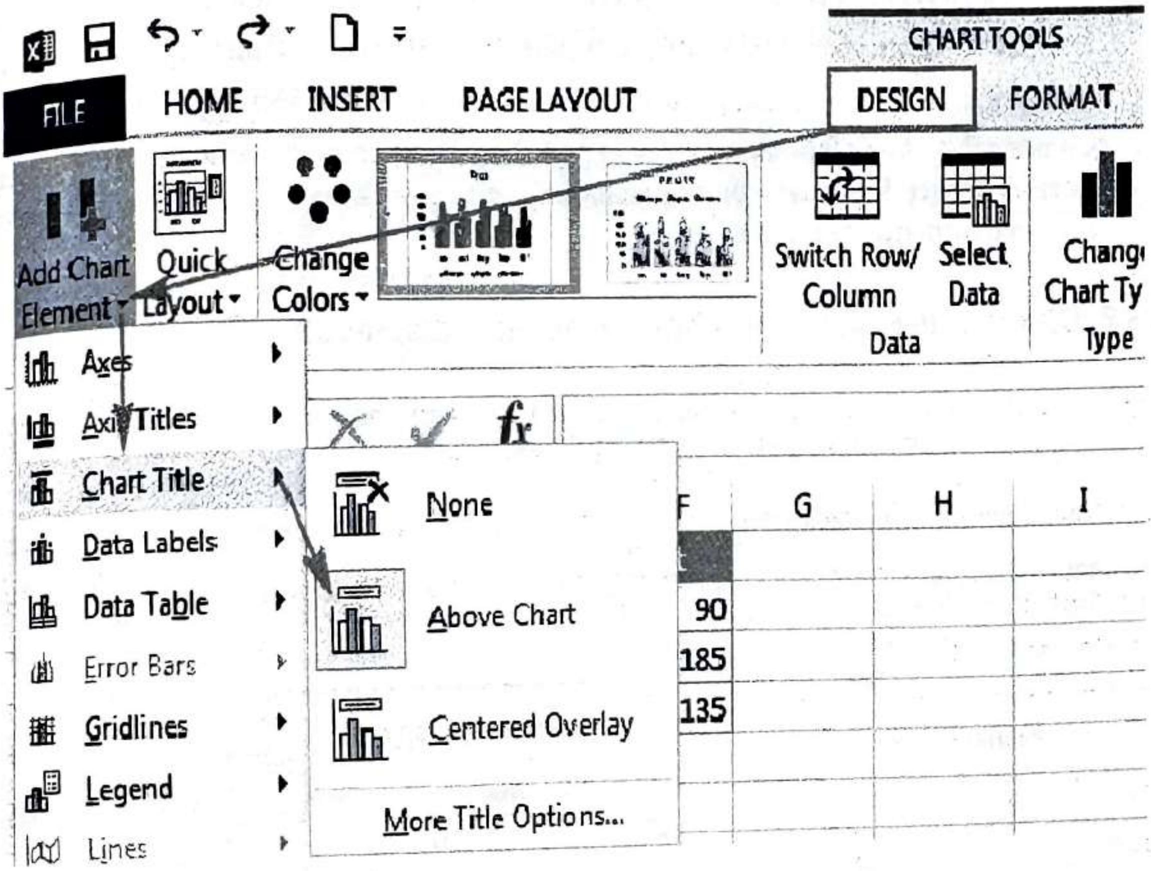


CHART TOOLS
FILE
HOME
INSERT
PAGE LAYOUT
DESIGN
FORMAT
Add Chart Element
Quick Layout
Change Colors
Switch Row/ Column
Select Data
Data
Change Chart Type
Type
Axes
Axis Titles
Chart Title
Data Labels
Data Table
Error Bars
Gridlines
Legend
Lines
None
Above Chart
Centered Overlay
More Title Options...
F
G
H
I
90
185
135

Or, click the *Chart Elements* button in the upper-right corner of the graph, and put a tick in the **Chart Title** checkbox.

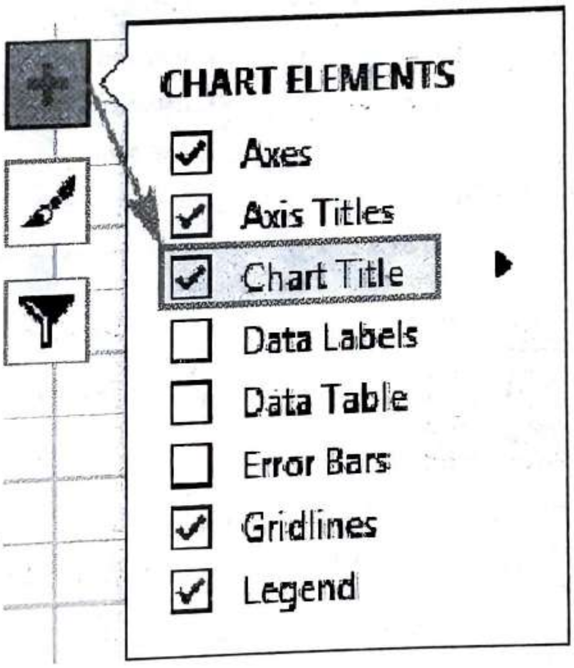


CHART ELEMENTS

☑ Axes
☑ Axis Titles
☑ Chart Title
☐ Data Labels
☐ Data Table
☐ Error Bars
☑ Gridlines
☑ Legend

Additionally, click the arrow next to *Chart Title* and chose one of the following options:

- *Above Chart* - the default option that displays the title at top of the chart area and chang the graph's size.
- *Centered Overlay* - overlays the centered title on the chart without resizing the graph.

For more options, go to the *Design tab* > *Add Chart Element* > *Chart Title* > *More Options*. Or, click the Chart Elements button and click *Chart Title* > *More Options...*

Clicking the *More Options* item (either on the ribbon or in the context menu) opens th Format Chart Title pane on the right side of the worksheet, where one can select th required formatting options.

8.2.3.2 Change the way the chart axes are displayed

For most chart types, the vertical axis (*value or Y axis*) and horizontal axis (*category or X axis*) are added automatically when a chart in Excel is prepared.

One can show or hide chart axes by clicking the Chart Elements button + , then clicking the arrow next to Axes, and then checking the boxes for the axes to be shown and unchecking those to be hidden.

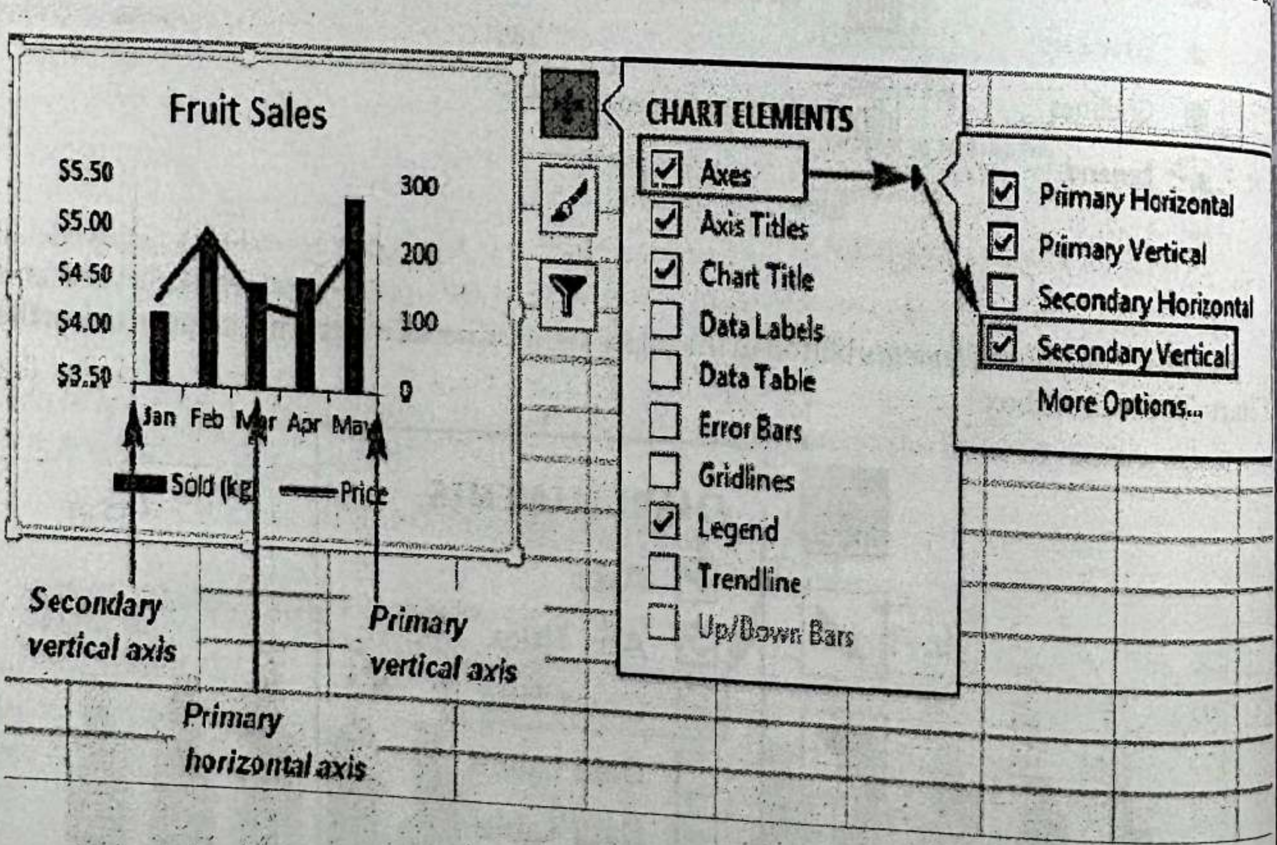


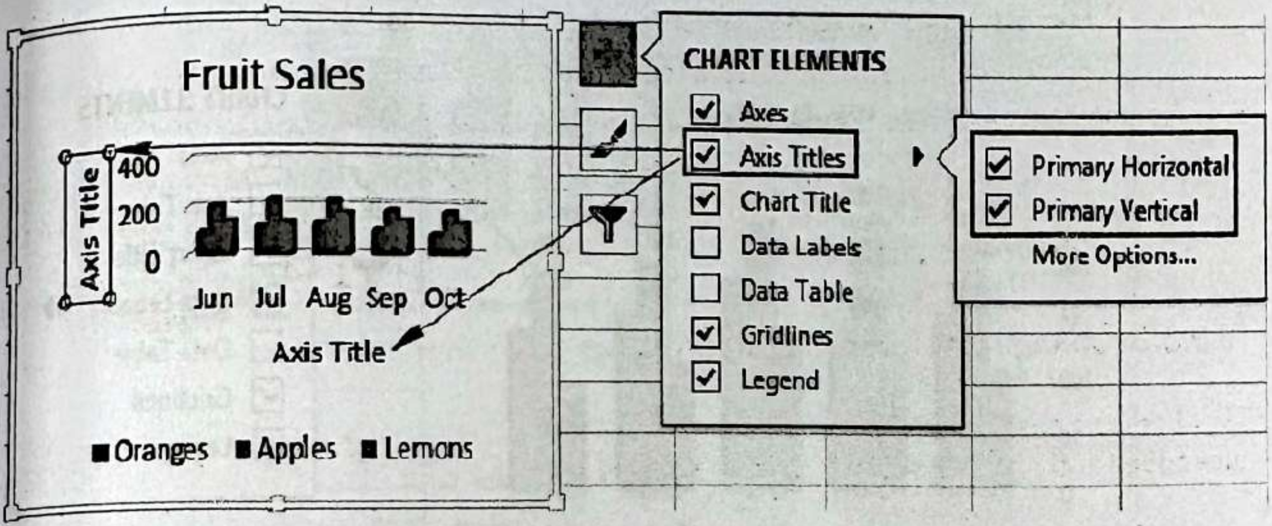
CHART ELEMENTS
☑ Axes
☑ Axis Titles
☑ Chart Title
☐ Data Labels
☐ Data Table
☐ Error Bars
☐ Gridlines
☑ Legend
☐ Trendline
☐ Up/Down Bars

☑ Primary Horizontal
☑ Primary Vertical
☐ Secondary Horizontal
☑ Secondary Vertical
More Options...

✓ Add axis titles to a chart

When creating graphs in Excel, titles can be added to the horizontal and vertical axes to help the users understand what the chart data is about. To add the axis titles, steps are as follows:

1. Click anywhere within the Excel chart, then click the Chart Elements button and check the Axis:


Fruit Sales
Axis Title
400
200
0
Jun Jul Aug Sep Oct
Axis Title
■Oranges ■Apples ■Lemons
CHART ELEMENTS
More Options...

☑ Axes
☑ Axis Titles
☑ Chart Title
☐ Data Labels
☐ Data Table
☑ Gridlines
☑ Legend

☑ Primary Horizontal
☑ Primary Vertical

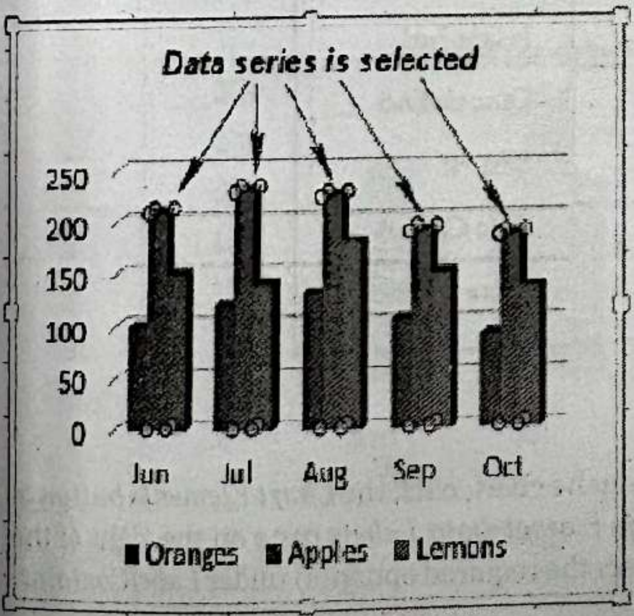
2. Click the axis title box on the chart and type the text.

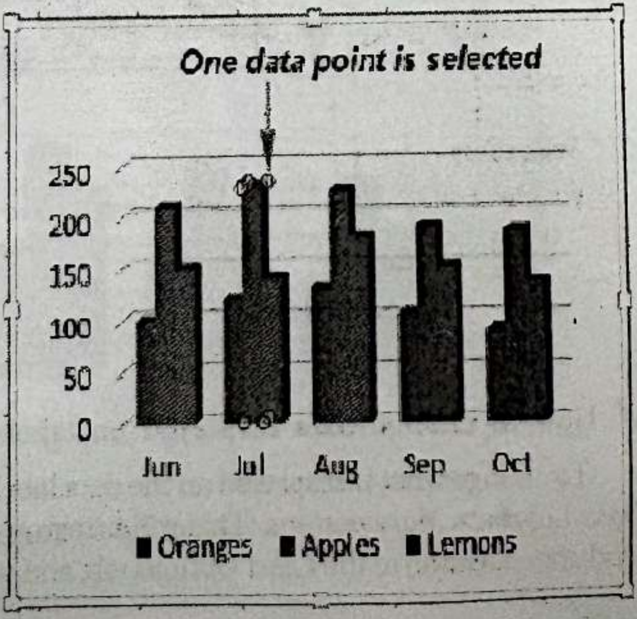
   To format the axis title, right-click it and select *Format Axis* Title from the context menu. The *Format Axis Title* pane will appear with lots of formatting options to choose from.

8.2.3.3 Adding data labels to Excel charts

To make the Excel graph easier to understand, data labels can be added to display details about the data series. Depending on where users' attentionneed to be focussed, \add labels to one data series, all the series, or individual data points.

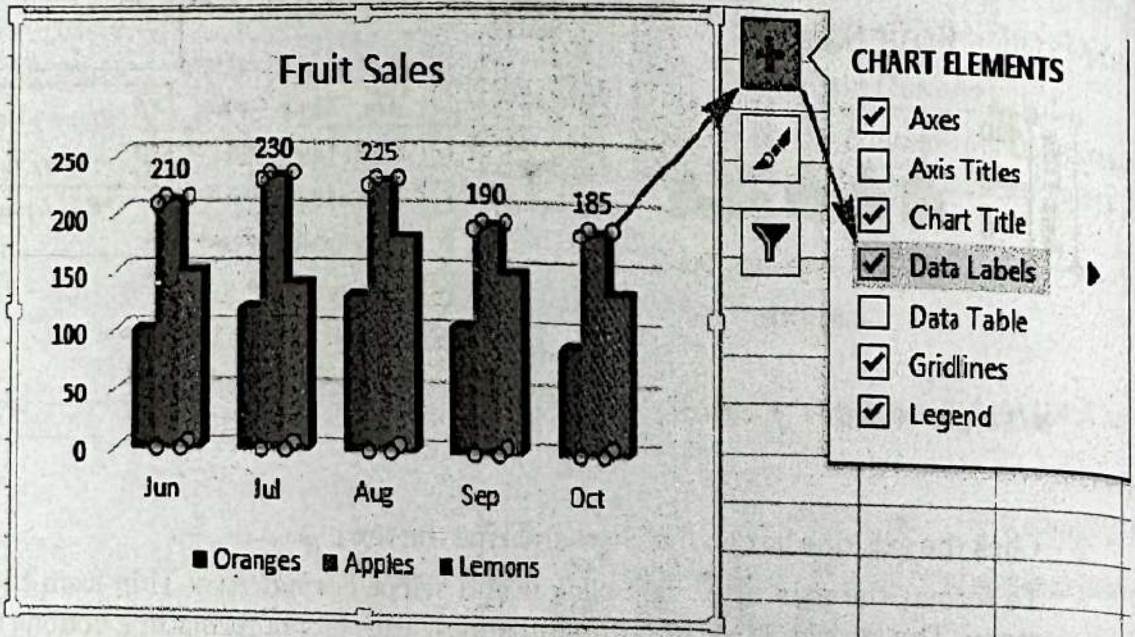
1. Click the data series to be labelled. To add a label to one data point, click that data point after selecting the series.


Data series is selected
250
200
150
100
50
0
Jun Jul Aug Sep Oct
■Oranges ■Apples ■Lemons


One data point is selected
250
200
150
100
50
0
Jun Jul Aug Sep Oct
■Oranges ■Apples ■Lemons

2. Click the Chart Elements button and select the Data Labels option.

   For example, this is how labels can be added to one of the data series in our Excel chart :


Fruit Sales
250
200
150
100
50
0
210
230
225
190
185
Jun
Jul
Aug
Sep
Oct
■ Oranges ■ Apples ■ Lemons
CHART ELEMENTS
☑ Axes
☐ Axis Titles
☑ Chart Title
☑ Data Labels ▶
☐ Data Table
☑ Gridlines
☑ Legend

For specific chart types, such as pie chart, the labels location can also be chosen. For this, click the arrow next to *Data Labels*, and choose the required option. To show data labels inside text bubbles, click *Data Callout*.

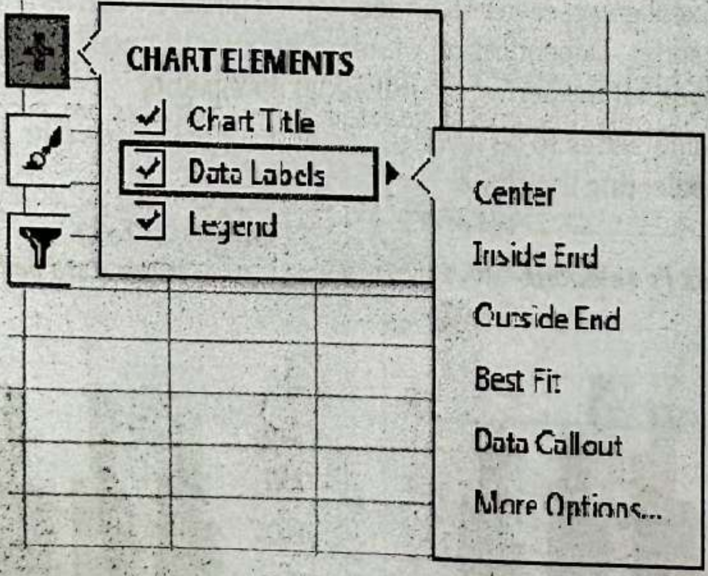
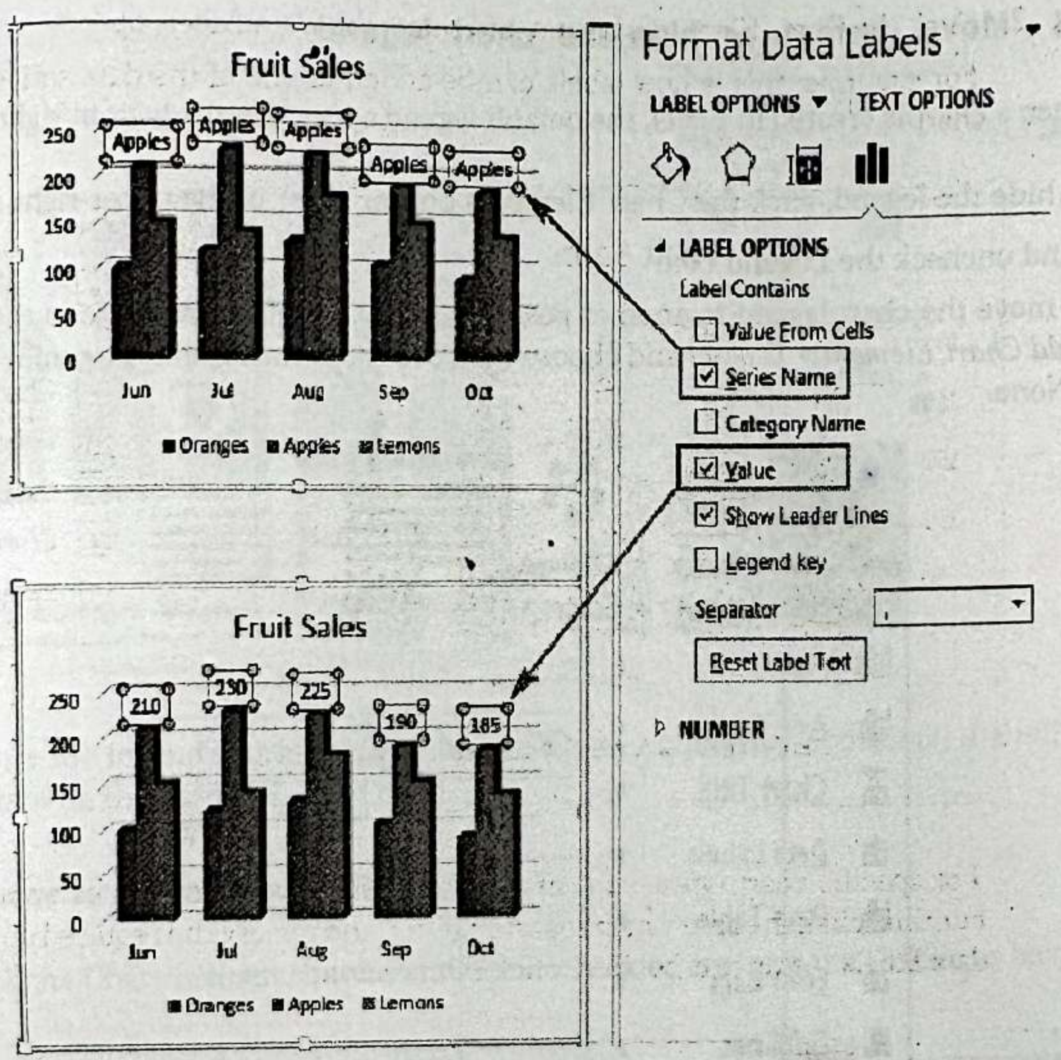


CHART ELEMENTS
✓ Chart Title
✓ Data Labels ▶
✓ Legend
Center
Inside End
Outside End
Best Fit
Data Callout
More Options...

✓ How to change data displayed on labels

To change what is displayed on the data labels in the chart, click the *Chart Elements button* > *Data Labels* > *More options*. This will bring up the *Format Data Labels* pane on the right of the worksheet. Switch to the *Label Options* tab, and select the required option(s) under *LabelContains*:


Fruit Sales
Apples
Apples
Apples
Apples
Apples
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
Oranges
Apples
Lemons
Fruit Sales
210
230
225
190
185
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
Oranges
Apples
Lemons
LABEL OPTIONS
TEXT OPTIONS
NUMBER

Format Data Labels

LABEL OPTIONS

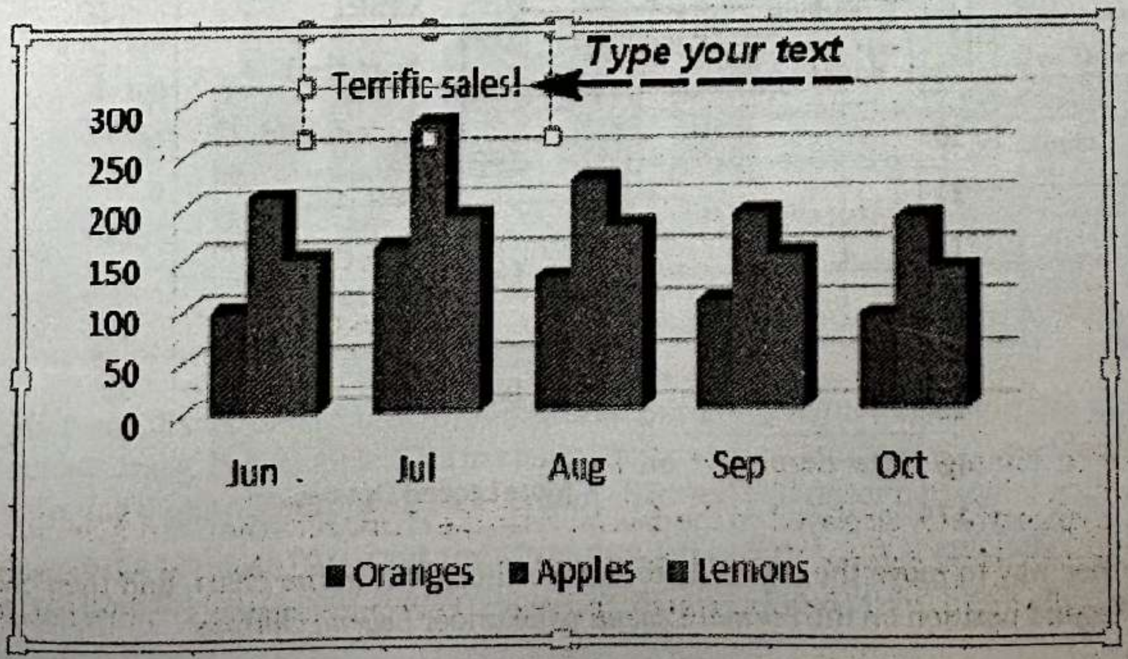
Label Contains

☐ Value From Cells
☑ Series Name
☐ Category Name
☑ Value
☑ Show Leader Lines
☐ Legend key

Separator ,

Reset Label Text

If one wants to add his/her own text for some data point, click the label for that data point and then click it again so that only this label is selected. Select the label box with the existing text and type the replacement text:

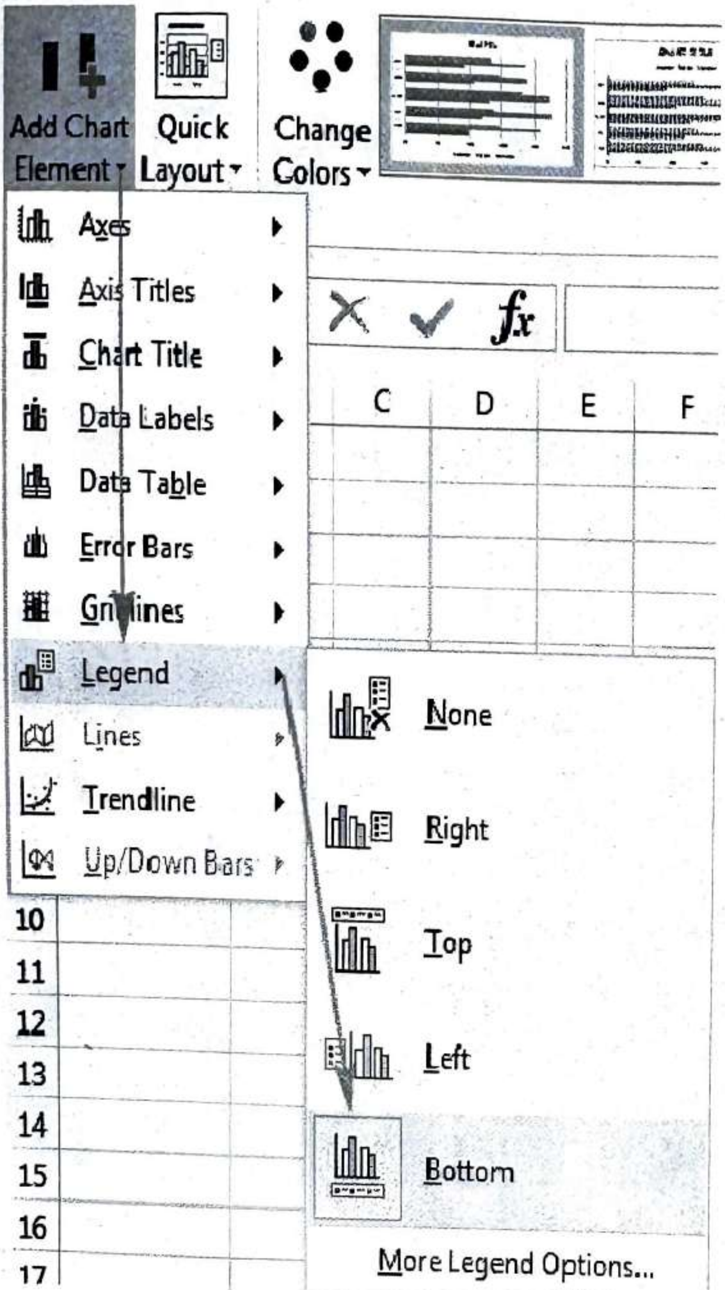

Type your text
Terrific sales!
300
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
Oranges
Apples
Lemons

8.2.3.4 Move, format, or hide the chart legend

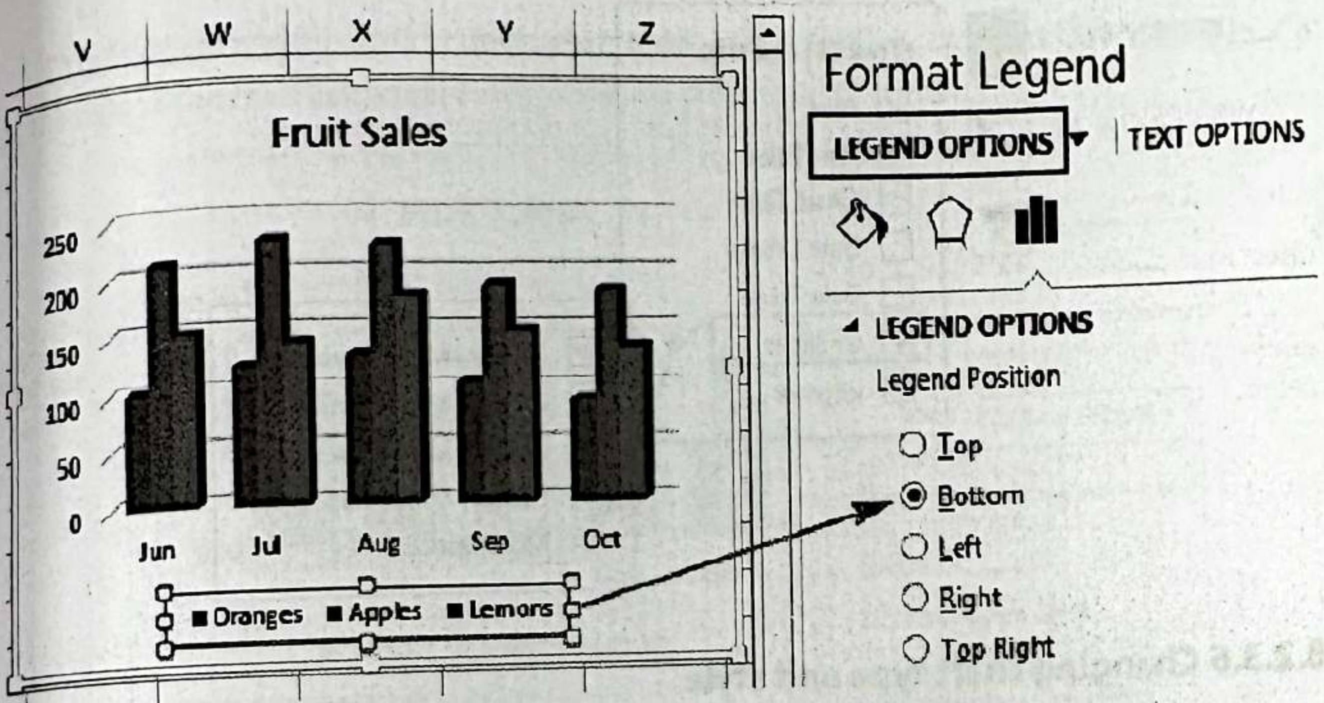
When a chart is created in Excel, the default legend appears at the bottom/right of the chart.

To hide the legend, click the Chart Elements button + in the upper-right corner of the chart and uncheck the Legend box.

To move the chart legend to another position, select the chart, navigate to the Design tab, click *Add Chart Element> Legend* and choose where to move the legend. To remove the legend, select None.


Add Chart Element
Quick Layout
Change Colors
Axes
Axis Titles
Chart Title
Data Labels
Data Table
Error Bars
Gridlines
Legend
Lines
Trendline
Up/Down Bars
fx
C
D
E
F
10
11
12
13
14
15
16
17
None
Right
Top
Left
Bottom
More Legend Options...

Another way to move the legend is to double-click on it in the chart, and then choose the desired legend position on the *Format Legend* pane under *Legend Options*.


V
W
X
Y
Z
Fruit Sales
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■ Oranges ■ Apples ■ Lemons

Format Legend

LEGEND OPTIONS | TEXT OPTIONS

LEGEND OPTIONS

Legend Position

○ Top
● Bottom
○ Left
○ Right
○ Top Right

To change the legend's formatting, there are plenty of different options on the *Fill & Line* and *Effects* tabs on the *Format Legend* pane.

8.2.3.5 Show or hide the gridlines

- Click the Chart Elementsbutton and either check or uncheck the Gridlines box.

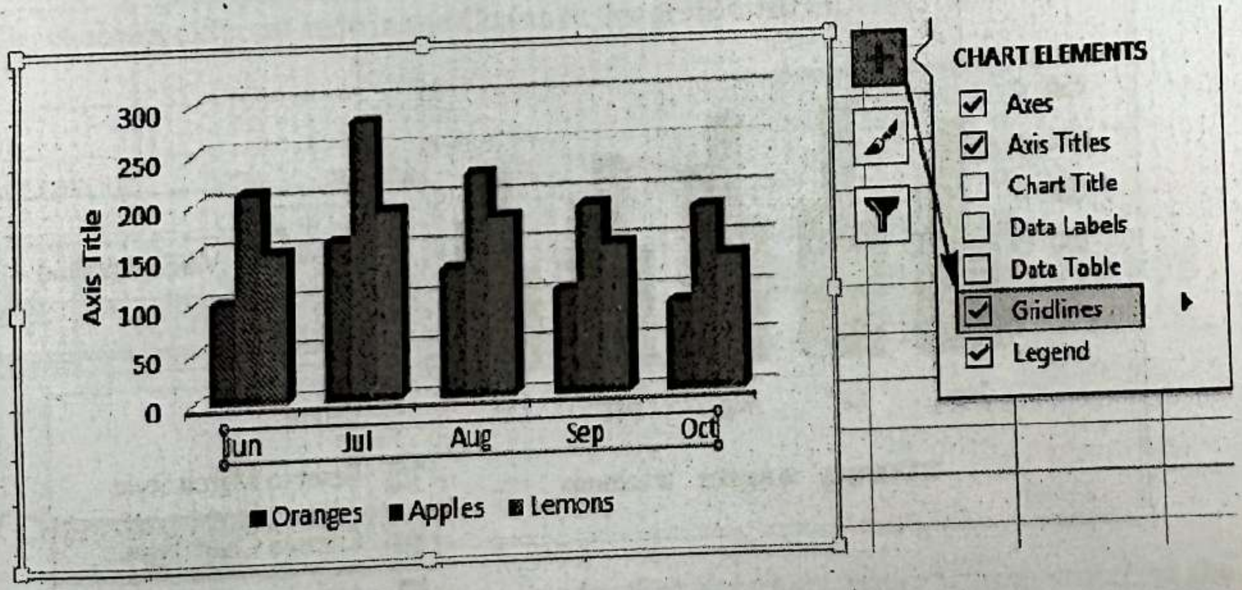

300
250
200
150
100
50
0
Axis Title
Jun
Jul
Aug
Sep
Oct
■ Oranges ■ Apples ■ Lemons

CHART ELEMENTS

☑ Axes
☑ Axis Titles
☐ Chart Title
☐ Data Labels
☐ Data Table
☑ Gridlines
☑ Legend

Microsoft Excel determines the most appropriate gridlines type for the chart type automatically. For example, on a bar chart, major vertical gridlines will be added, whereas selecting the *Gridlines option* on a column chart will add major horizontal gridlines.

To change the gridlines type, click the arrow next to *Gridlines*, and then choose the desired gridlines type from the list, or click *More Options...* to open the pane with advanced *Major Gridlines* options.

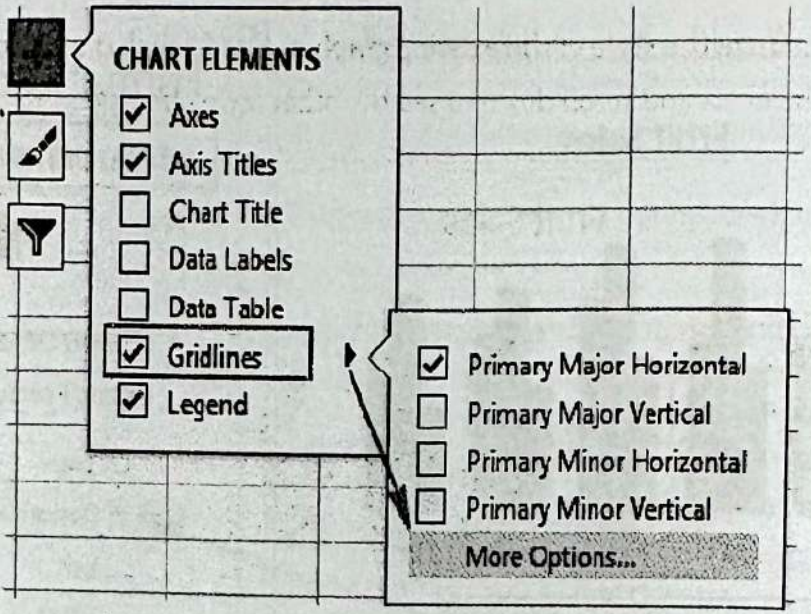
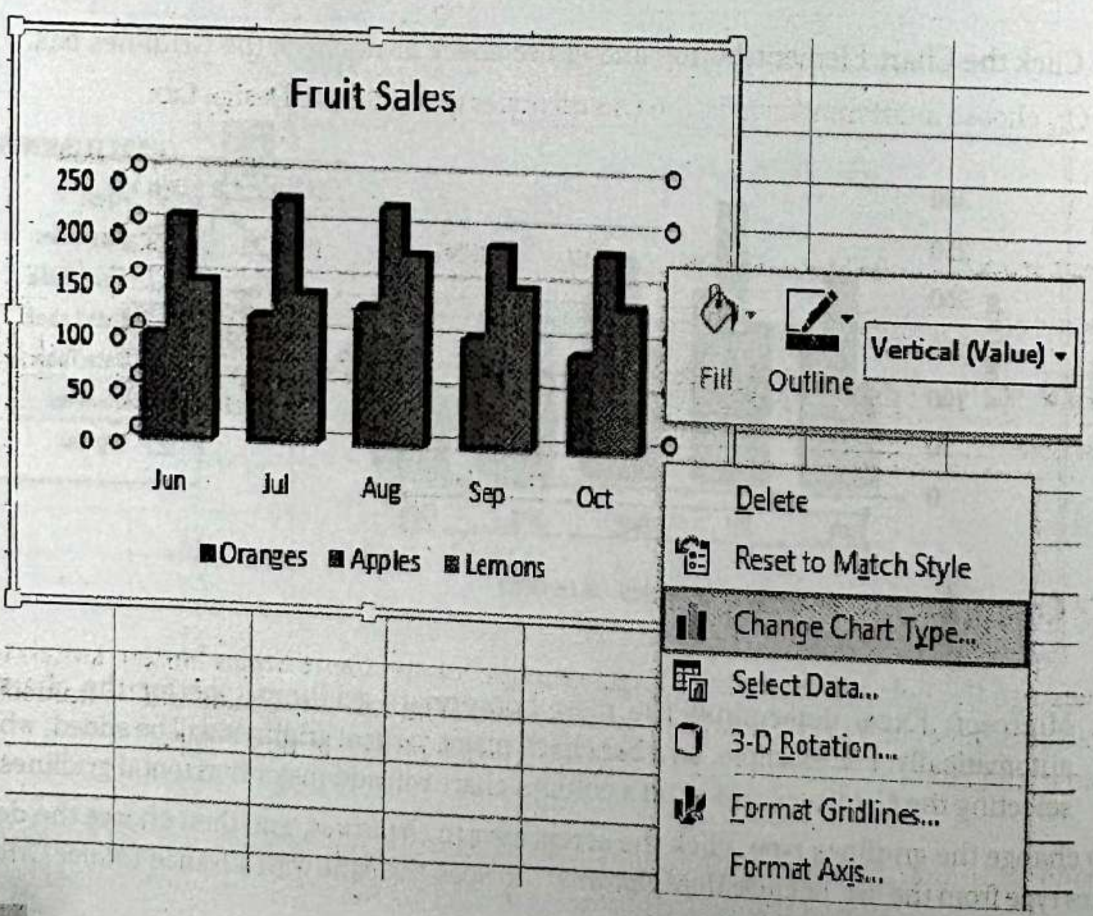


CHART ELEMENTS
☑ Axes
☑ Axis Titles
☐ Chart Title
☐ Data Labels
☐ Data Table
☑ Gridlines
☑ Legend
☑ Primary Major Horizontal
☐ Primary Major Vertical
☐ Primary Minor Horizontal
☐ Primary Minor Vertical
More Options...

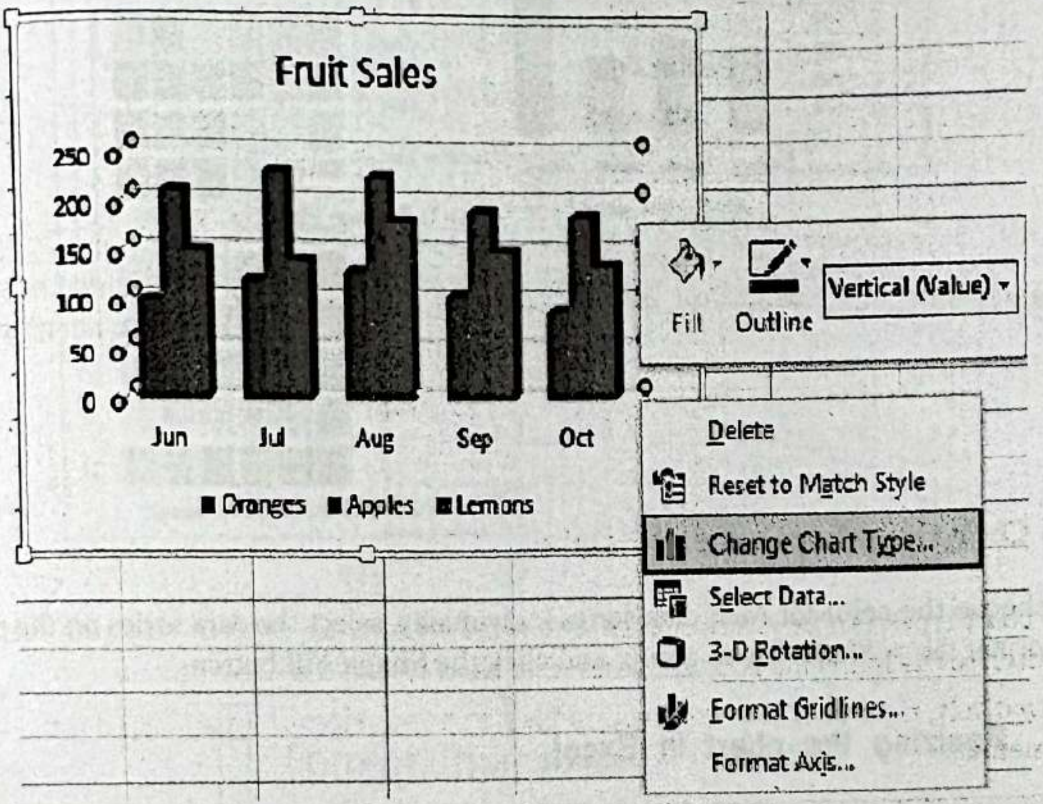
8.2.3.6 Changing chart type and style

One chart types can be easily change it to some other chart type by selecting the existing chart, switch to the Insert tab and choose another chart type in the Charts group.

Alternatively, right-click anywhere within the graph and select Change Chart Type... from the context menu.


Fruit Sales
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■ Oranges ■ Apples ■ Lemons
Fill
Outline
Vertical (Value)
Delete
Reset to Match Style
Change Chart Type...
Select Data...
3-D Rotation...
Format Gridlines...
Format Axis...

To quickly change the style of the existing graph in Excel, click the Chart Styles button on the right of the chart and scroll down to see the other style offerings.


Fruit Sales
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■ Oranges
■ Apples
■ Lemons
Fill
Outline
Vertical (Value)
Delete
Reset to Match Style
Change Chart Type...
Select Data...
3-D Rotation...
Format Gridlines...
Format Axis...

Or, choose a different style in the Charts Styles group on the Design tab:

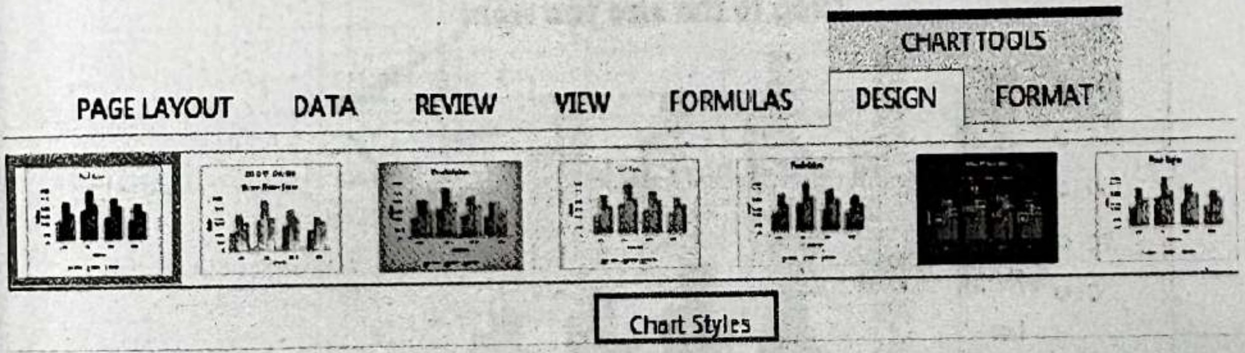
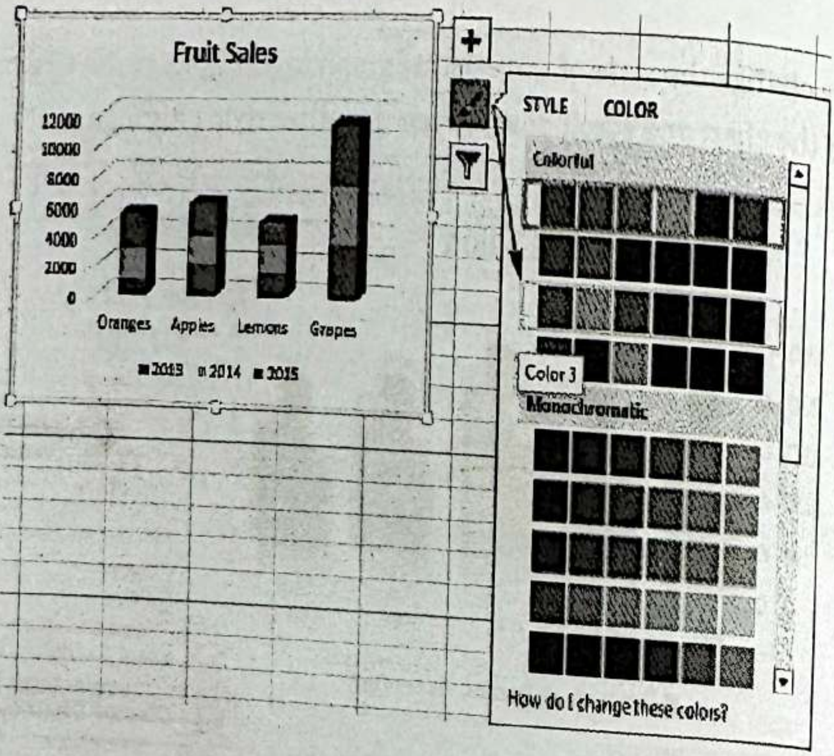


CHART TOOLS
PAGE LAYOUT
DATA
REVIEW
VIEW
FORMULAS
DESIGN
FORMAT
Chart Styles

8.2.3.7 Changing chart colors

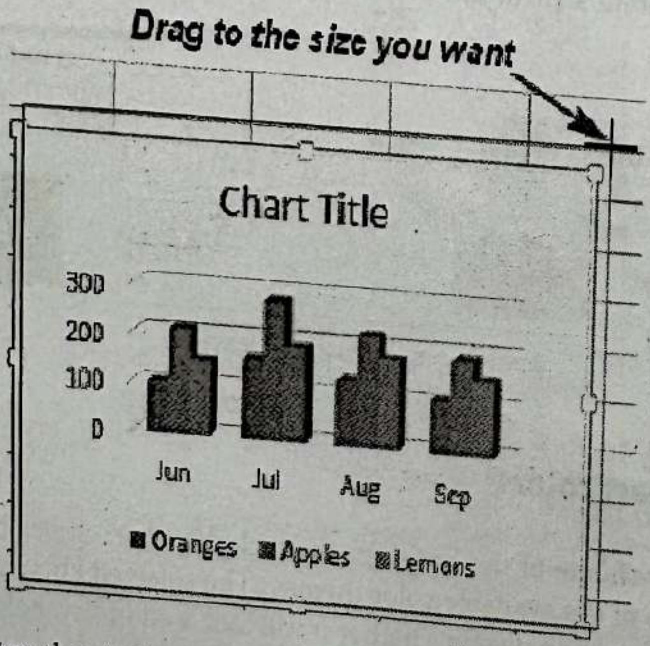
To change the color theme of the Excel graph, click the *Chart Styles* button, switch to the Color tab and select one of the available color themes. The selected choice will be immediately reflected in the chart, so one can decide whether it will look well in new colors.


Fruit Sales
12000
10000
8000
6000
4000
2000
0
Oranges
Apples
Lemons
Grapes
2013
2014
2015
STYLE
COLOR
Colorful
Color 3
Monochromatic
How do I change these colors?

To choose the color for each data series individually, select the data series on the chart, go to the Format tab > Shape Styles group, and click the Shape Fill button:

8.2.3.8 Resizing the chart in Excel

To resize the Excel graph, click on it, and then drag the sizing handles to the required size.


Drag to the size you want
Chart Title
300
200
100
0
Jun
Jul
Aug
Sep
Oranges
Apples
Lemons

Alternatively, enter the desired chart height and width in the Shape Height and Shape Width boxes on the Format tab, in the Size group:

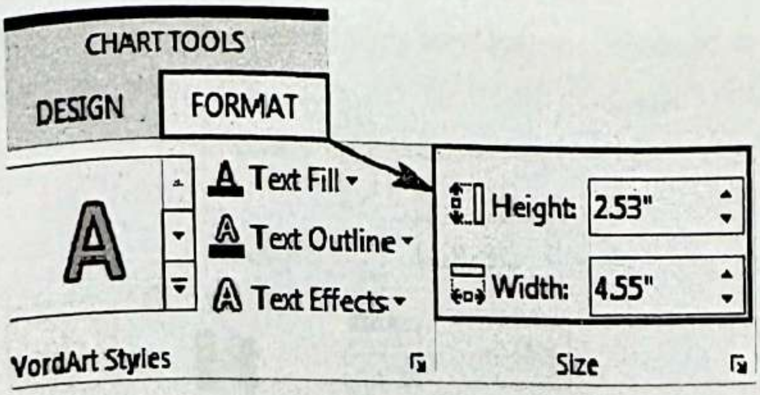
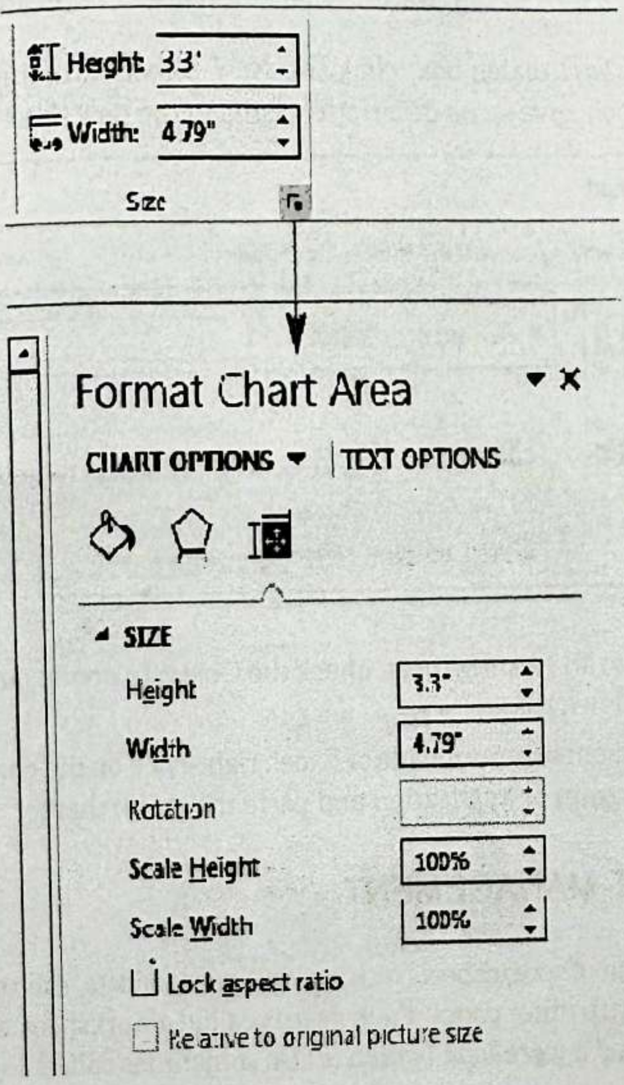


CHART TOOLS
DESIGN
FORMAT
Text Fill
Text Outline
Text Effects
VordArt Styles
Size

Height: 2.53"

Width: 4.55"

For more options, click the Dialog Box Launcher next to Size and configure the needed parameters on the pane.


Size
Format Chart Area
CHART OPTIONS
TEXT OPTIONS
SIZE

Height: 3.3"

Width: 4.79"

Height 3.3"

Width 4.79"

Rotation

Scale Height 100%

Scale Width 100%

☐ Lock aspect ratio

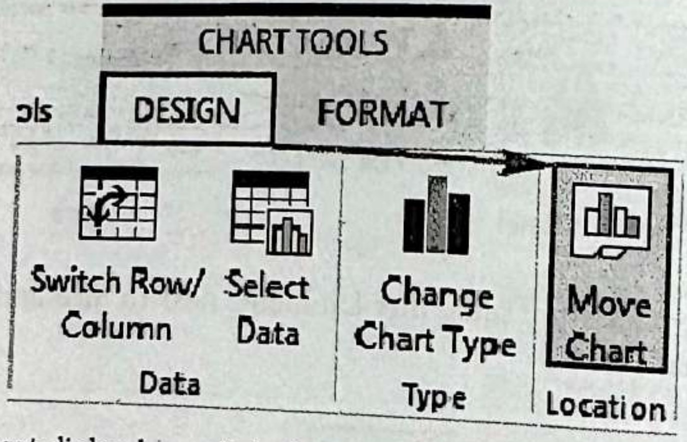
☐ Relative to original picture size

8.2.4 Moving the chart in Excel

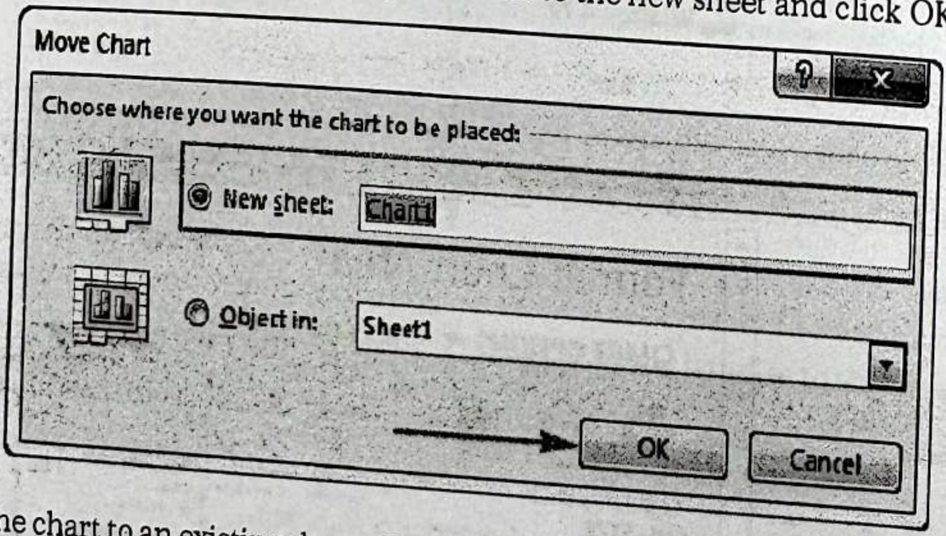
When a graph is created in Excel, it is automatically embedded on the same worksheet as the source data. One can move the chart to any location on the sheet by dragging it with the mouse.

If graph is to be moved on a separate sheet, it can be done in the following way.

1. Select the chart, go to the Design tab on the ribbon and click the Move Chart button.



2. In the *Move Chart* dialog box, click the New Sheet. If multiple chart sheets are to be inserted in the workbook, give some descriptive name to the new sheet and click OK.


Move Chart

Choose where you want the chart to be placed:

● New sheet: Chart1

○ Object in: Sheet1

To move the chart to an existing sheet, check the Object In option, and then select the needed worksheet in the drop-down list.

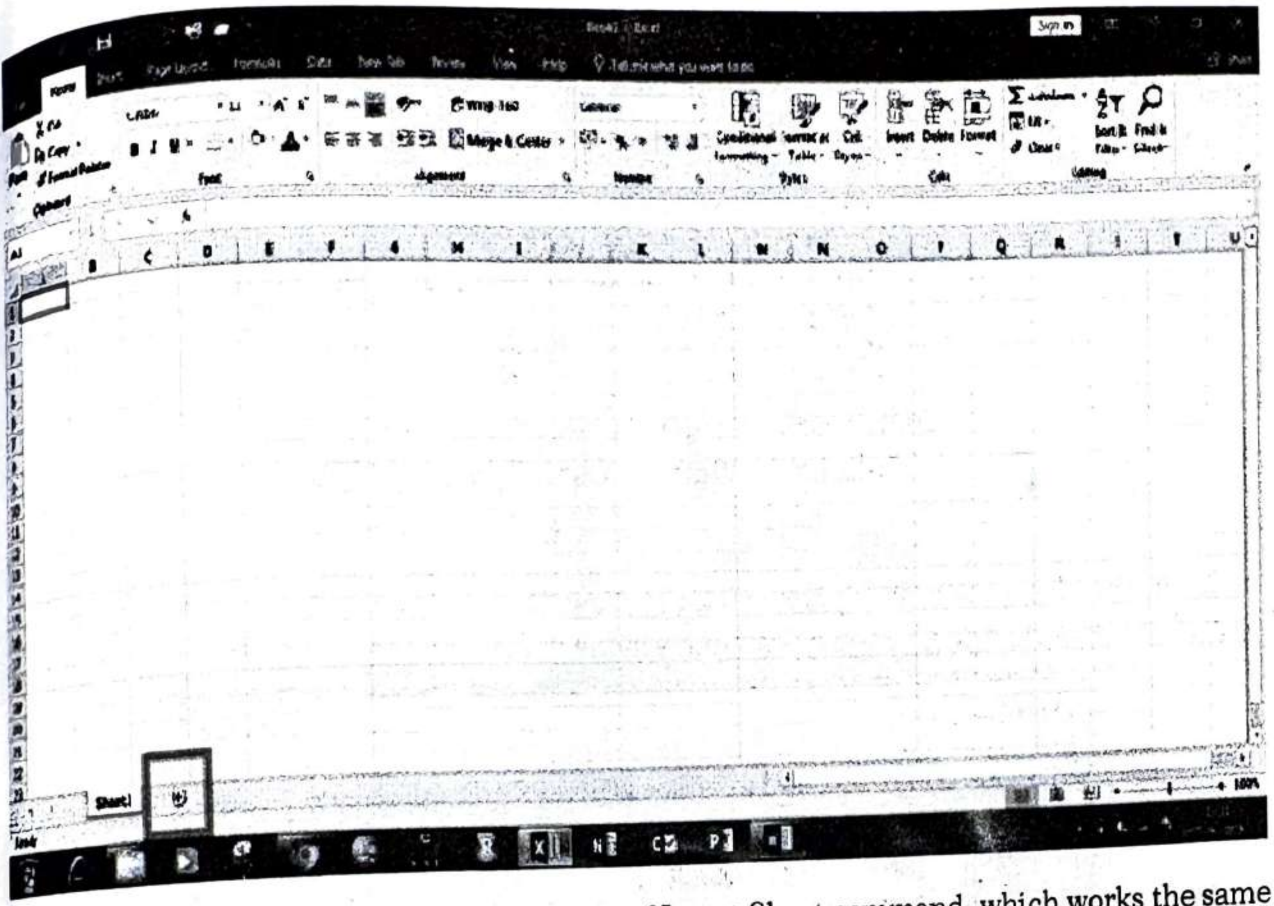
To export the chart somewhere outside of Excel, right-click on the chart border and click Copy. Then open another program or application and paste the graph there.

8.3 WORKSHEET MANAGEMENT

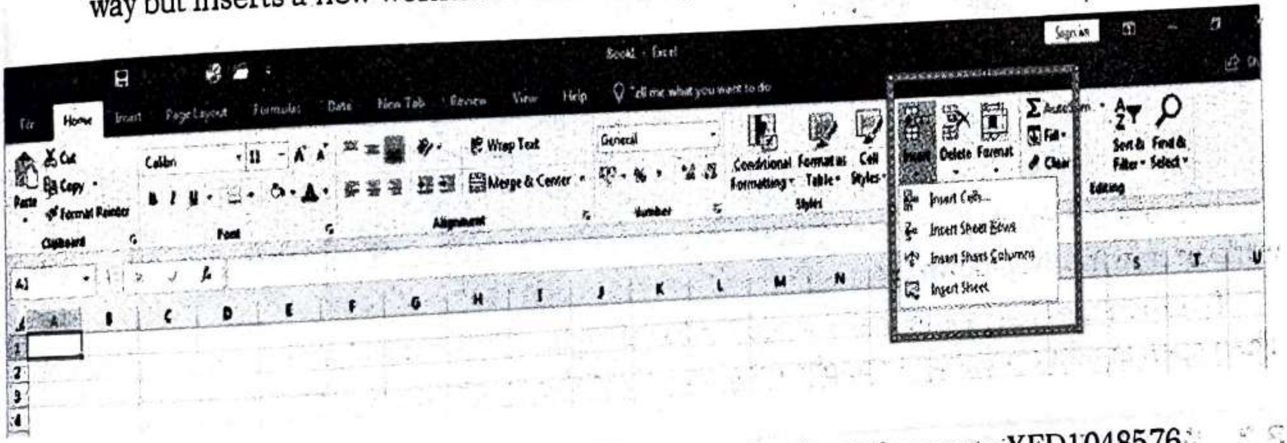
Excel lets the creation of spreadsheets with multiple pages of data, each of which can conveniently exchange information with other pages. Each page is called a worksheet, and a collection of one or more worksheets is called a *workbook* (which is also sometimes called a *spreadsheet file*).

8.3.1 Adding and Removing Worksheets

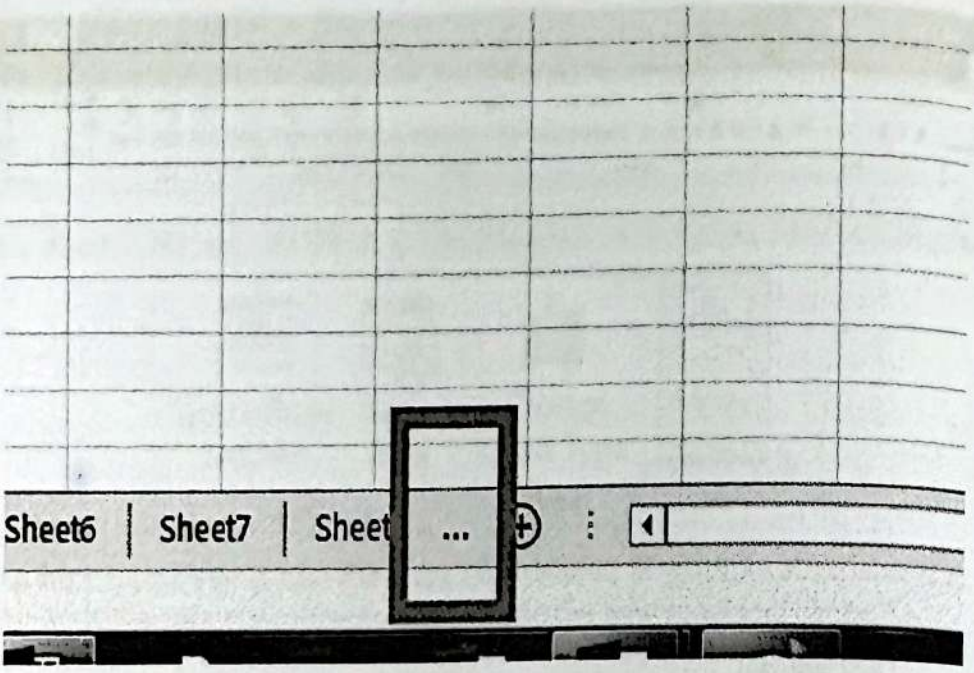
1. When one starts a fresh workbook in Excel, a single blank worksheet is seen. To add more sheets, one need to click the "New sheet" button, which is a small plus-in-a-circle icon that appears immediately to the right of the last worksheet tab.


Sign in
Home
Insert
Page Layout
Formulas
Data
Review
View
Help
Tell me what you want to do
Wrap Text
Merge & Center
Conditional Formatting
Format as Table
Cell Styles
Insert
Delete
Format
Sort & Filter
Find & Select
Font
Alignment
Number
Styles
Cells
Editing
Clipboard
Sheet1
Ready
100%

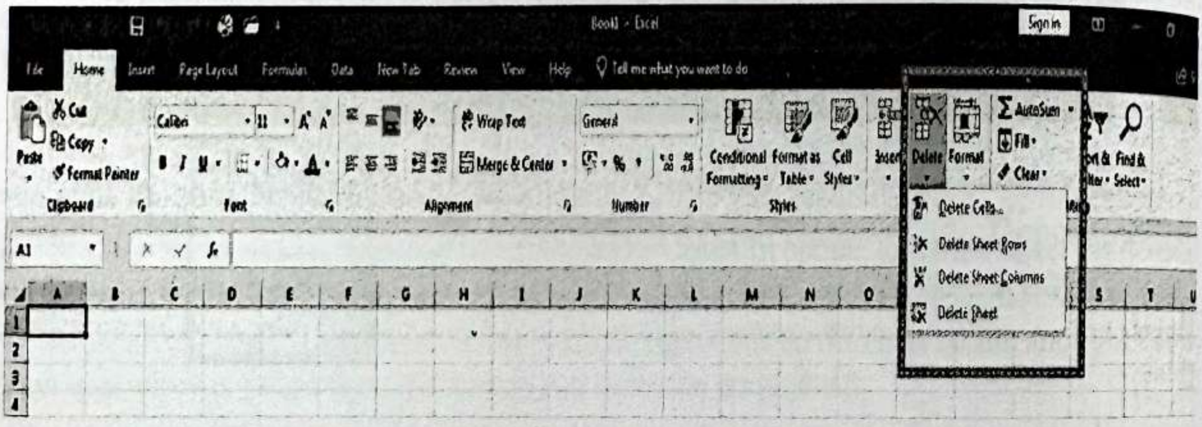
2. One can also use the Home?Cells?Insert?Insert Sheet command, which works the same way but inserts a new worksheet immediately to the left of the current worksheet.


Book1 - Excel
Sign in
File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell me what you want to do
Cut
Copy
Format Painter
Paste
Clipboard
Calibri
11
Font
Wrap Text
Merge & Center
Alignment
General
Number
Conditional Formatting
Format as Table
Cell Styles
Styles
Insert
Delete
Format
AutoSum
Fill
Clear
Sort & Filter
Find & Select
Editing
Insert Cells...
Insert Sheet Rows
Insert Sheet Columns
Insert Sheet
A1

3. Each worksheet contains a fresh grid of cells—from A1 all the way to XFD1048576.
4. If one continues adding worksheets, it will be found that all the worksheet tabs won't fit at the bottom of the workbook window. Excel uses an ellipsis (...) to indicate the next tab that doesn't fit. For example, if the workbook has worksheets named Sheet1, Sheet2, and Sheet3, and the tab for Sheet3 doesn't quite fit into view at the end of the list, one will see the ellipsis instead.


Sheet6
Sheet7
Sheet
...

5. Removing a worksheet is just as easy as adding one. Simply move to the sheet to get rid of, and then choose *Home→Cells→Delete→Delete Sheet* (alternatively right-click a tab, and then choose Delete). Excel won't complain if oneask it to remove a blank worksheet, but if one try to remove a sheet that contains data, Excel displays a warning message asking for the confirmation.


Book1 - Excel
Sign in
File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell me what you want to do
Cut
Copy
Format Painter
Paste
Clipboard
Font
Wrap Text
Merge & Center
Alignment
General
Number
Conditional Formatting
Format as Table
Cell Styles
Styles
Insert
Delete
Format
AutoSum
Fill
Clear
Sort & Filter
Find & Select
Delete Cells...
Delete Sheet Rows
Delete Sheet Columns
Delete Sheet
A1

If there is one last worksheet, Excel won't remove it. Doing so would create a tough existential dilemma for Excel—a workbook that holds no worksheets—so the program prevents from taking this step.

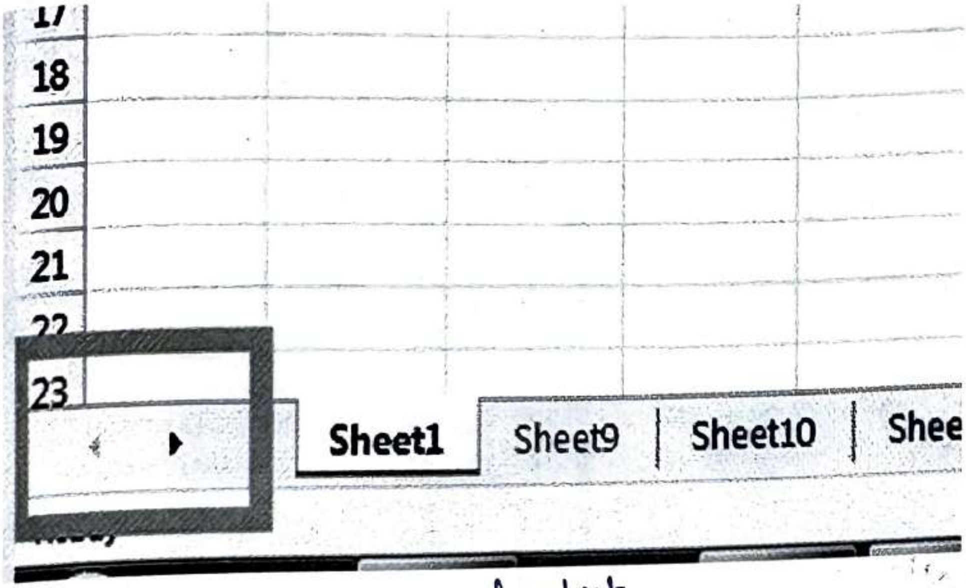
Be careful before deleting a worksheet, because it can't be reversed by using Undo (Ctrl+Z)!

8.3.2 Moving Between Worksheets

To move from one worksheet to another, one have a few choices:

Choice 1 : Click the worksheet tabs at the bottom of Excel's grid window (just above the status bar).

Choice 2 : If onehave way more worksheets than fit into the tab list, one will need to use the scroll buttons, which are immediately to the left of the worksheet tabs) to review the list of worksheets.



Choice 3 : Keyboard Shortcut bottom of sheet

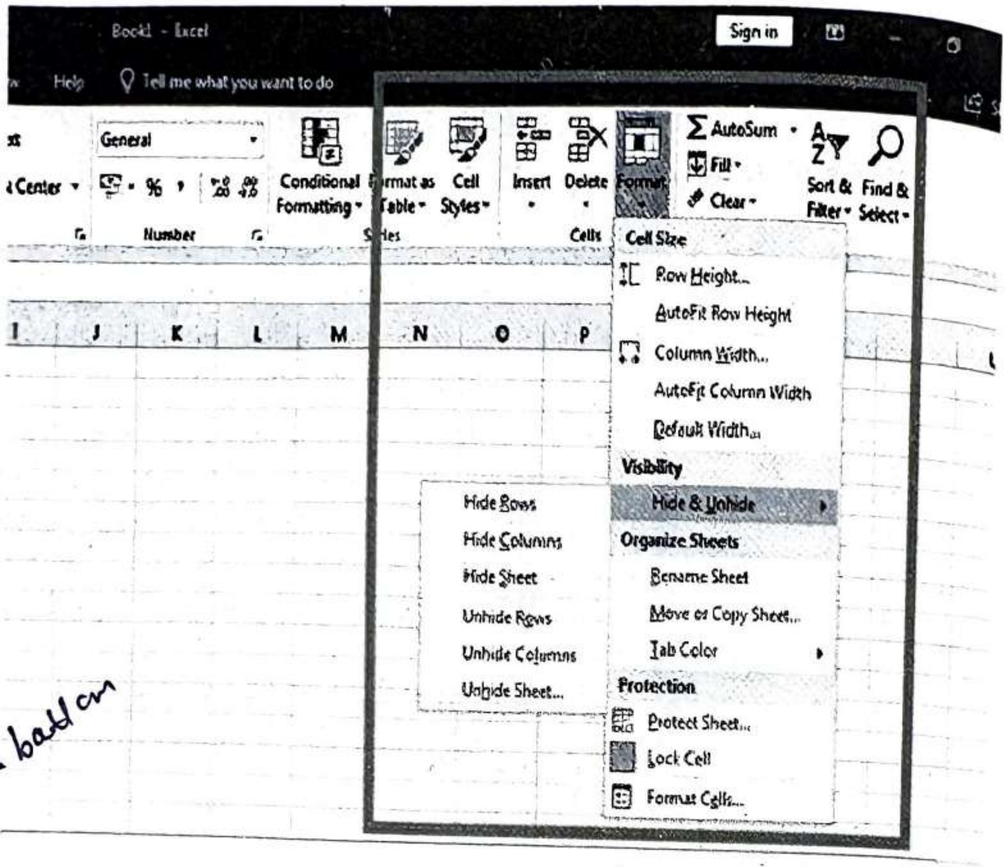
- Press Ctrl+Page Down to move to the next worksheet. For example, if one is currently in Sheet1, this key sequence jumps him/her to Sheet2 (assuming the sheets are in order).
- Press Ctrl+Page Up to move to the previous worksheet. For example, if one is currently in Sheet2, this key sequence takes him/her to Sheet1.

top of sheets.

8.3.3 Hiding Worksheets

Deleting worksheets isn't the only way to tidy up a workbook or get rid of information one doesn't want. A worksheet can also be hidden temporarily.

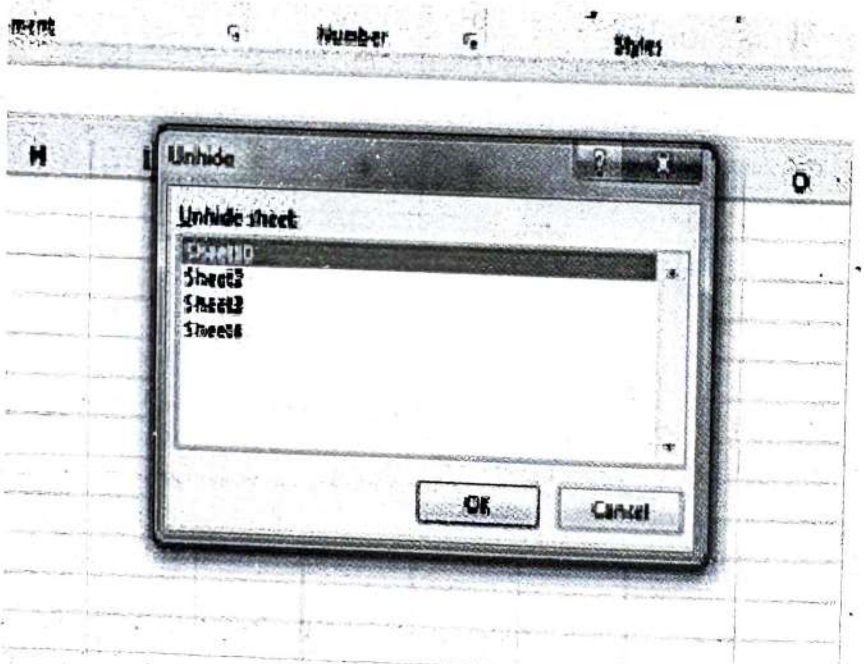
When onehides a worksheet, its tab disappears, but the worksheet itself remains part of the workbook file, and is available whenever one choose to unhide it. One can't print a hidden worksheet, either.


Book1 - Excel
Sign in
Help
Tell me what you want to do
General
Center
Number
Conditional Formatting
Format as Table
Cell Styles
Styles
Insert
Delete
Format
Cells
AutoSum
Fill
Clear
Sort & Filter
Find & Select
Cell Size
Row Height...
AutoFit Row Height
Column Width...
AutoFit Column Width
Default Width...
Visibility
Hide & Unhide
Organize Sheets
Rename Sheet
Move or Copy Sheet...
Tab Color
Protection
Protect Sheet...
Lock Cell
Format Cells...
Hide Rows
Hide Columns
Hide Sheet
Unhide Rows
Unhide Columns
Unhide Sheet...

Unhide by Shortcut from sheet button

To hide a worksheet, right-click the worksheet tab, and then choose Hide. (Or, for a more long-winded approach, choose Home→Cells→Format→Hide&Unhide→Hide Sheet)

same process to unhide.


Number
Styles
Unhide
Unhide sheet:
Sheet10
Sheet2
Sheet3
Sheet4
OK
Cancel

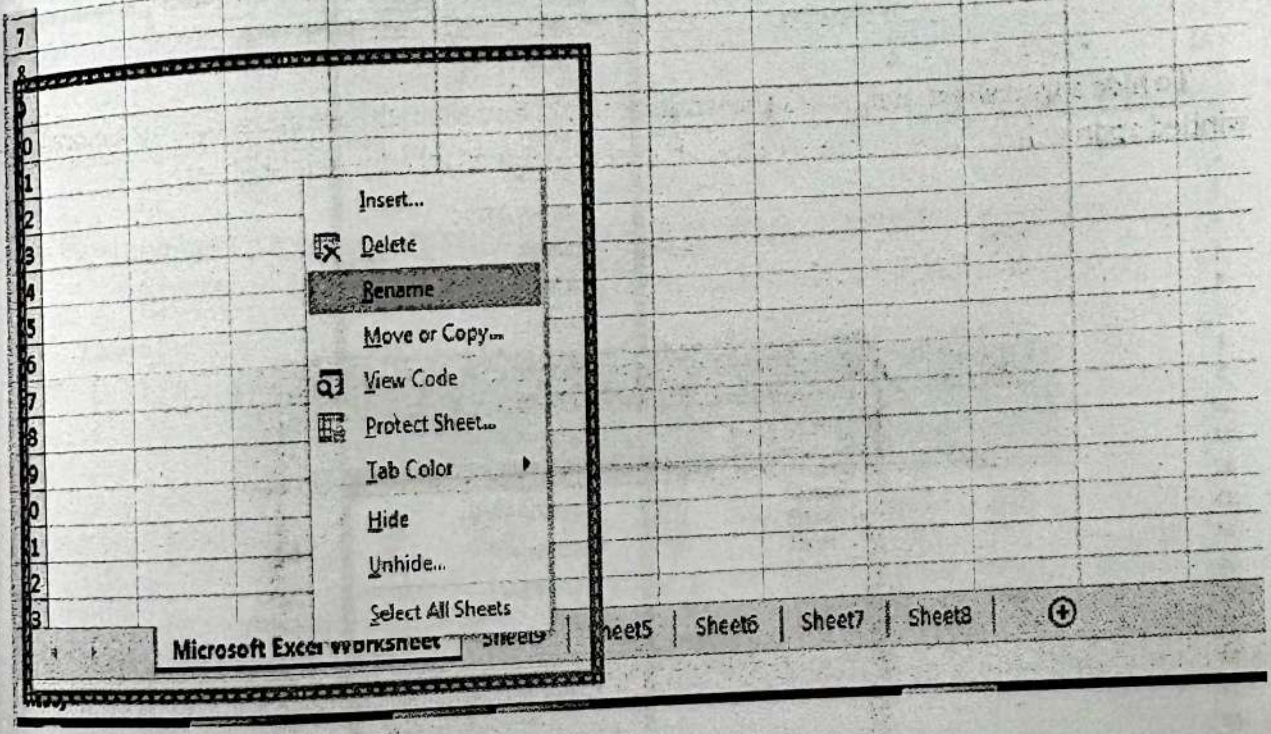
To redisplay a hidden worksheet, right-click any worksheet tab, and then choose Unhide. The Unhide window appears along with a list of all hidden sheets.

Select a sheet from the list, and then click OK to unhide it. (Once again, the ribbon the same window—just click Home?Cells?Format?Hide&Unhide?Unhide Sheet.)

8.3.4 Naming Worksheets ✓

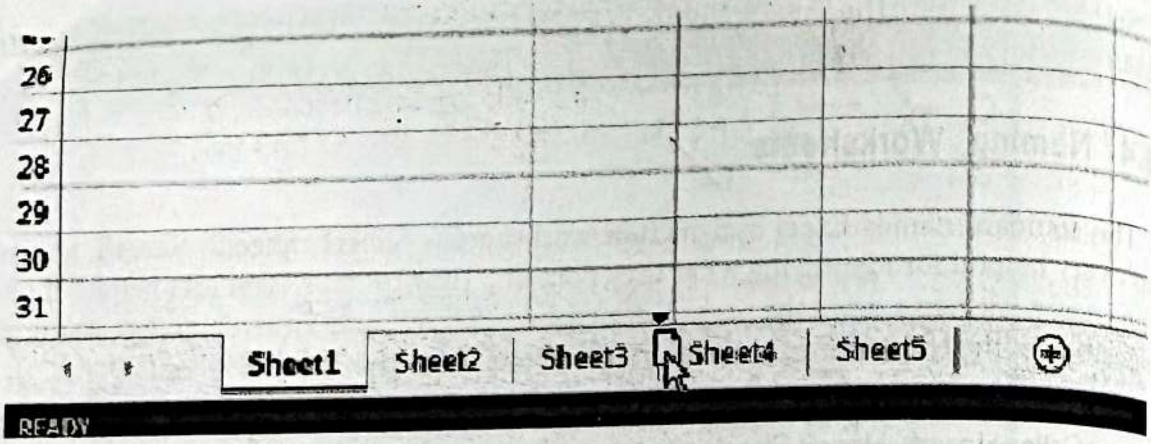
The standard names Excel assigns new worksheets—Sheet1, Sheet2, Sheet3, and so on—aren't very helpful for identifying what they contain. They become even less helpful if one start adding new worksheets, since the new sheet numbers (Sheet2, and so on) don't necessarily indicate the position of the sheets, just the order in which one created them.

For example, if one is on Sheet 3 and one add a new worksheet (by choosing Home→Cells→Insert→Insert Sheet), then the worksheet tabs read: Sheet1, Sheet2, Sheet4, Sheet3. (That's because the Insert Sheet command inserts the new sheet just before the current sheet.) Excel doesn't expect one to stick with these auto-generated names. Worksheets can be renamed by right-clicking the worksheet tab and selecting Rename, or by just double-clicking the sheet name. Either way, Excel highlights the worksheet tab, and a new name can be typed directly in the tab. The worksheet names can have up to 31 characters and include letters, numbers, some symbols, and spaces.



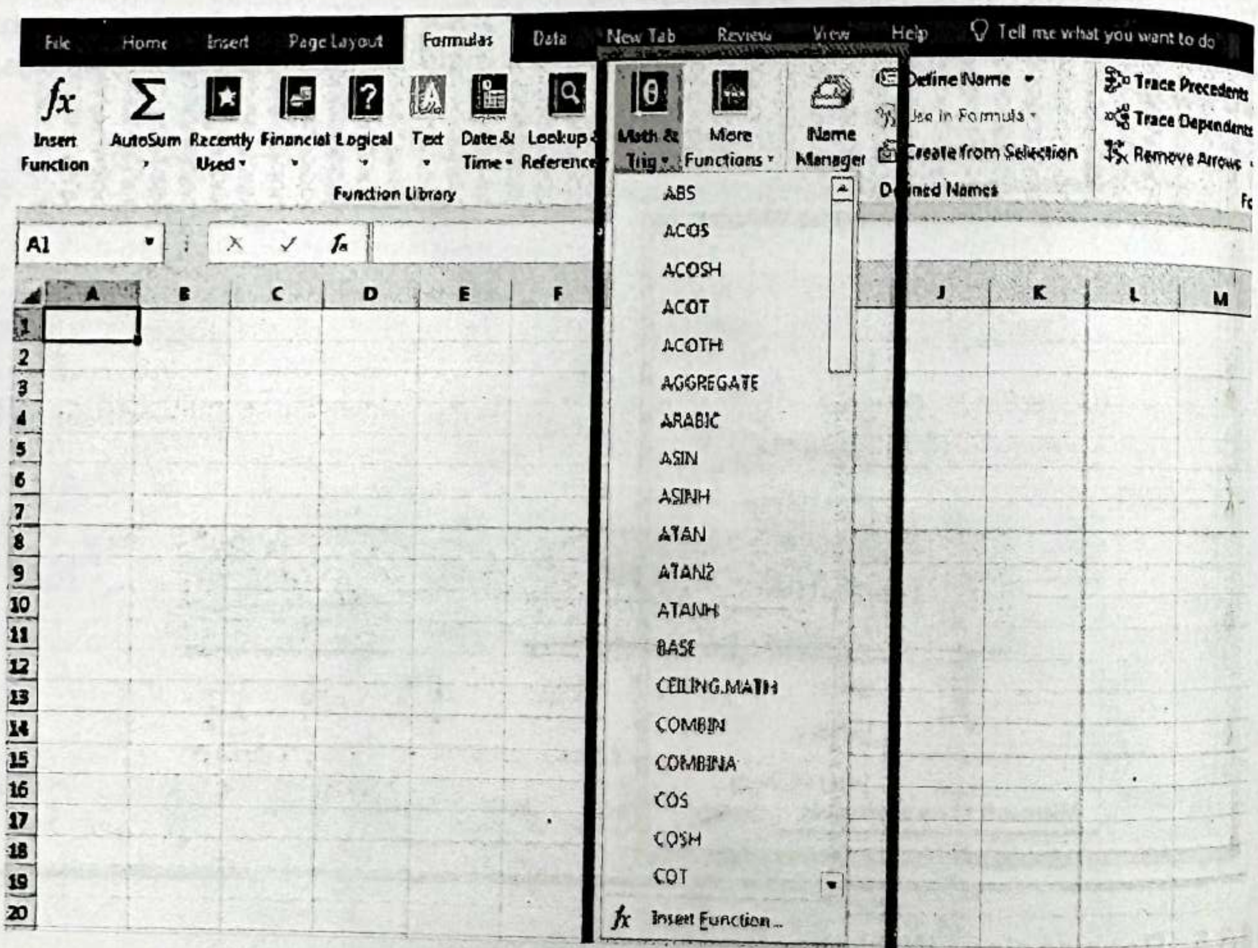
8.3.5 Rearranging Worksheets

One can easily rearrange any of their sheets just by dragging their tabs from one place to another. When a worksheet tab is dragged, a tiny page appears beneath the arrow cursor. As the cursor is moved around, a black triangle appear, indicating where the worksheet will land when the mouse button will be released.


26
27
28
29
30
31
Sheet1
Sheet2
Sheet3
Sheet4
Sheet5
READY

8.4 MATHEMATICAL FUNCTIONS

There are numerous mathematical and Trigonometric functions in Excel.


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell me what you want to do
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
More Functions
Name Manager
Define Name
Use in Formula
Create from Selection
Defined Names
Trace Precedents
Trace Dependents
Remove Arrows
Function Library
A1
ABS
ACOS
ACOSH
ACOT
ACOTH
AGGREGATE
ARABIC
ASIN
ASINH
ATAN
ATAN2
ATANH
BASE
CEILING.MATH
COMBIN
COMBINA
COS
COSH
COT
Insert Function...

The most commonly used Mathematical Functions are as follows:

8.4.1 PRODUCT function

The PRODUCT function multiplies all the numbers given as arguments and returns the product. For example, if cells A1 and A2 contain numbers, the formula =PRODUCT(A1, A2) can be used to

multiply those two numbers together. The same operation can be performed by using the
(*) mathematical operator; for example, =A1 * A2.

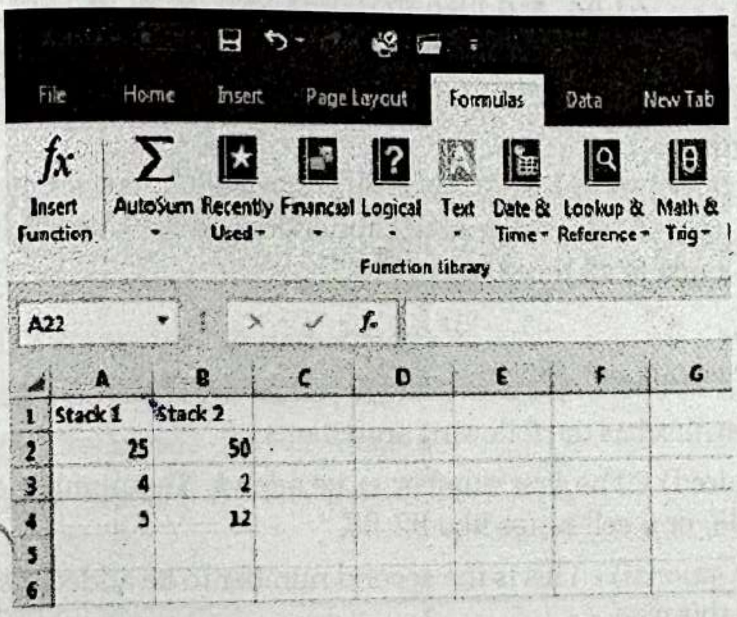
The PRODUCT function is useful when many cells together need to be multilied. For exa
the formula =PRODUCT(A1:A3, C1:C3) is equivalent to =A1 * A2 * A3 * C1 * C2 * C3.

✓ **Syntax**

PRODUCT(number1, [number2], ...)

The PRODUCT function syntax has the following arguments:

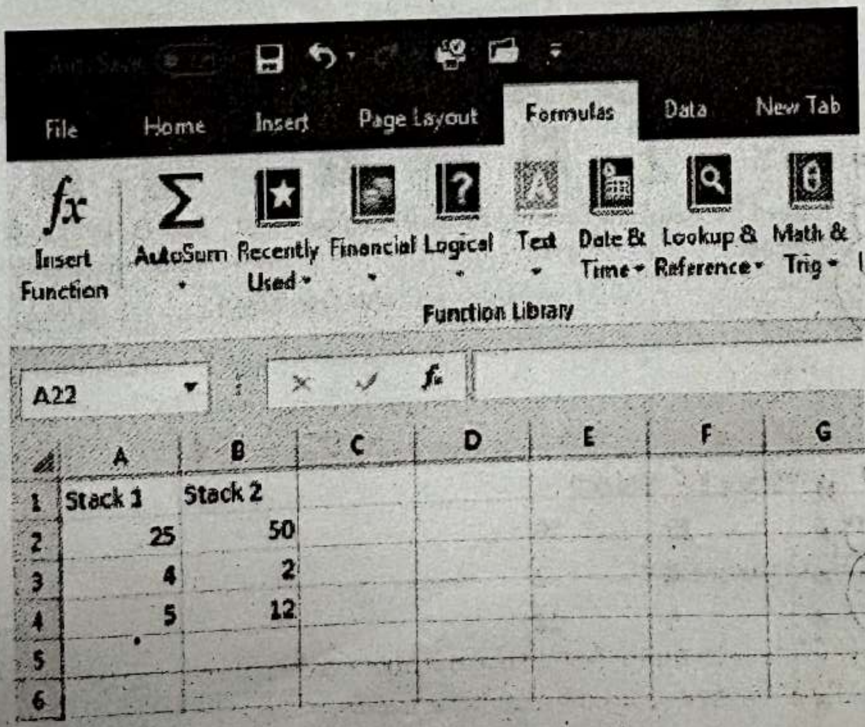
- number1 (Required) - The first range that need to be multiplied.


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
Function library
A22

	A	B	C	D	E	F	G
1	Stack 1	Stack 2					
2	25	50					
3	4	2					
4	5	12					
5							
6							

- number2 (Optional) - Additional numbers or ranges that need to be multiplied, up to a maximum of 255 arguments.

✓ Example:


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
Function Library
A22

	A	B	C	D	E	F	G
1	Stack 1	Stack 2					
2	25	50					
3	4	2					
4	5	12					
5							
6							

Formula	Description	Result
=PRODUCT(A2:A4)	Multiplies the numbers in cells A2 through A4.	500
=PRODUCT(A2:A4, 3)	Multiplies the numbers in cells A2 through A4, and then multiplies that result by 3.	1500
=PRODUCT(A2:A4, B2:B4)	Multiplies the numbers in cells A2 through A4, and then multiplies that result by cells B2 through B4	600000

8.4.2 SUM Function

The SUM function, one of the math and trig functions, adds values of Individual cells, cell references or ranges or a mix of all three.

✓ Syntax

SUM (number1,[number2],...)

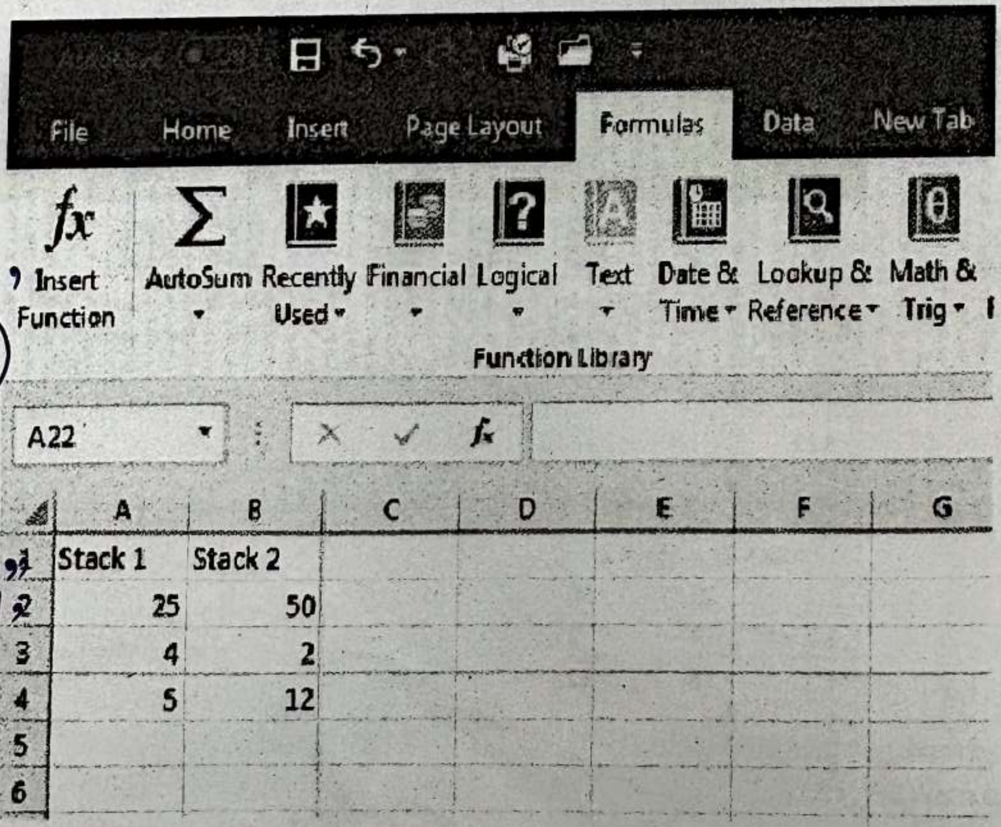
The SUM function syntax has the following arguments:

- number1 (Required) - The first number to be added. The number can be like 4, a cell reference like B6, or a cell range like B2:B8.
- number2-255 (Optional) - This is the second number to be added. One can specify up to 255 numbers in this way.

✓ Example :

umiF
select
(Range, "Grocery", Range,sales)

umiFs
(sales range, "Grocery" range, "state" range, "bihar")


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
Function Library
A22
fx

	A	B	C	D	E	F	G
1	Stack 1	Stack 2					
2	25	50					
3	4	2					
4	5	12					
5							
6							

7

CHAPTER

Desktop Components–

Word Processor, Presentation Software and Spreadsheets

LEARNING OUTCOMES

- ☐ Word Processor and its features
- ☐ Presentation Software and its features
- ☐ MS-EXCEL, its features and its applications

7.0 INTRODUCTION TO WORD PROCESSOR

A word processor is a type of software application used for composing, editing, formatting and printing documents. Word processors have a variety of uses and applications within the business environment, at home and in educational contexts.

Word processors are used to create, edit and print documents, and well as save them electronically.Today, the word processor is one of the most frequently used software programs on a computer, with Microsoft Word being the most popular word processor.

Word processing includes several tools to format the pages. For example, text can be organized into columns, add page numbers, insert illustrations, etc. However, word processing does not give complete control over the look and feel of the document. When design becomes important, one may need to use desktop publishing software to give more control over the layout of the pages.

Word processing software typically also contains features to make it easier to perform repetitive tasks. For example, let's say one need to send a letter to all his/her customers regarding a new policy. The letter is the same for all customers except for the name and address at the top of the letter. A mail merge function allows to produce all the letters using one template document and a table with customer names and addresses in the database.

Text editors shouldn't be confused with word processing software. While they do also allow to create, edit and save text documents, they only work on plain text. Text editors don't use any formatting, such as underlined text or different fonts. Text editors serve a very different purpose from word processing software. They are used to work with files in plain text format, such as source code of computer programs or configuration files of an operating system. An example of a text editor would be Notepad on the Windows platform.

Word processors can be used to create multiple types of files, including text files (.txt), rich text files (.rtf), HTML files (.htm & .html), and Wordfiles (.doc & .docx). Some word processors can also be used to create XML files (.xml).

The basic layout of the Microsoft Word is shown in Figure 7.1. In a word processor, blank white sheet is presented. The text is added to the document area and after it has been inserted formatted or adjusted to the user's preference.

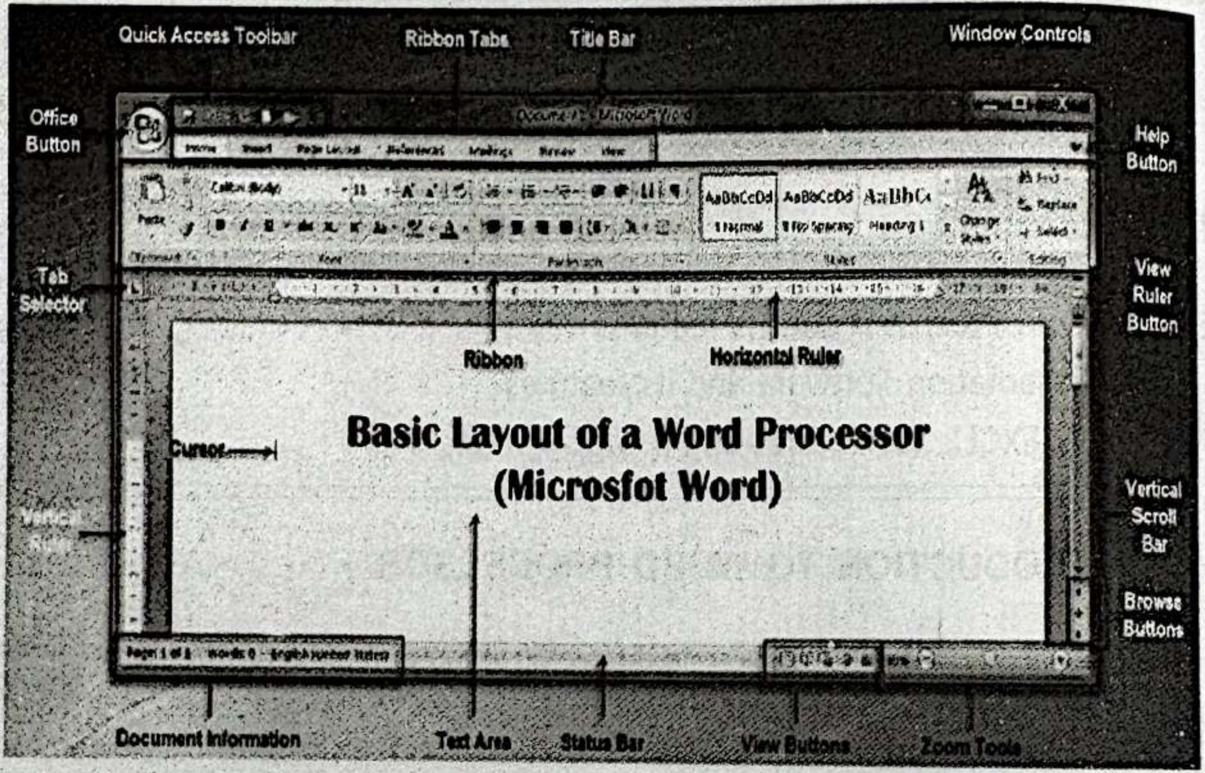

Quick Access Toolbar
Ribbon Tabs
Title Bar
Window Controls
Office Button
Help Button
Tab Selector
View Ruler Button
Ribbon
Horizontal Ruler
Cursor
Basic Layout of a Word Processor
(Microsfot Word)
Vertical Ruler
Vertical Scroll Bar
Browse Buttons
Document Information
Text Area
Status Bar
View Buttons
Zoom Tools

Figure 7.1: Basic Layout of Microsoft word

Apart from MS word, other word processors are shown in Figure 7.2

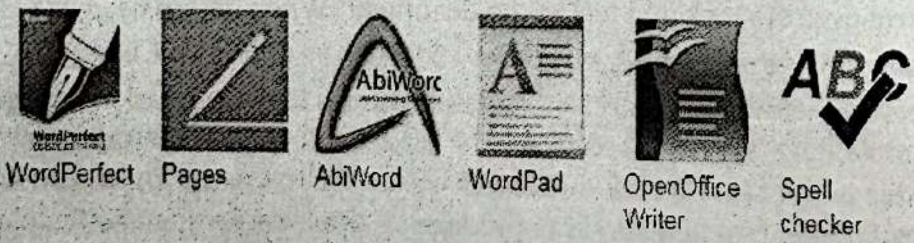

WordPerfect
Pages
AbiWord
WordPad
OpenOffice Writer
Spell checker

Figure 7.2 : Examples of Word processor

7.1 FEATURES OF A WORD PROCESSOR

Unlike a basic plaintext editor, a word processor offers dozens of additional features that can give the document or other text a more professional appearance. Below is a listing of some of the most popular features of a word processor.

Basic Features :

1. Insert : This feature helps to insert text, images shapes etc in the document. Any text can be inserted into the document by placing the insertion point where text need to be added.
2. Copy : This feature helps in duplicating the text in various other documents. This can be done by selecting the text, then right click, then select copy command. This feature will help to copy the text in other documents keeping the text in the original document intact. The keyboard shortcut for copy is Ctrl +C.
3. Cut and paste : Cut command removes the text from the original document. The keyboard shortcut for cut is Ctrl + X. Paste command helps in inserting the copied text in another document. The keyboard shortcut for paste is Ctrl +V.
4. Delete : This feature helps to remove the characters/text from the document.
5. Find and replace : This feature can be used when one need to search for a specific word, number, or phrase in a document and replace it with something else. This is quite useful if one need to make a lot of replacements at once like changing the name of the main character in a novel one has written or something one have consistently misspelled.Fortunately, Word can be told to make all of the changes automatically. Numbers, punctuation, and even cap or uncap words can also be replaced; just type what to find and what to replace it with.The keyboard shortcut Ctrl + H will also open the Find and Replace button.
6. Print : This feature allows to send a document to the printer to get the hardcopy
7. Word wrap : In word processing, a feature that causes the word processor to force all text to fit within the defined margins. When one line is filled with text, the word processor automatically jumps to the next line so that it is not required to keep track of line lengths and to press the Return key after each line. The word processor divides lines in such a way that a word is never split between two lines (unless the word processor supports *hyphenation*). Word wrap also occurs if the margins are changed. In this case, the word processor readjusts all the text so that it fits within the new margins.

Advanced Features :

1. File management : A file management system is a type of software that manages data files in a computer system. It has limited capabilities and is designed to manage individual or group files, such as special office documents and records. It may display report details, like owner, creation date, state of completion and similar features useful in an office environment. A file management system is also known as a file manager.
2. Graphics : *Graphic* design is an *important* tool that enhances how to communicate with other people. It serves to convey the ideas in a way that is not only effective, but also beautiful. Word processor allows to add graphics like charts, pictures, animations, audio, video etc into a word document.

3. **Font specification** - The fonts add value to the text. It helps readers to perceive information from the text. The correct choice of color, font and text size can prove to be vital for attracting the target audience. It's easy to attract the readers using typography but holding their attention requires more creativity. Word processor allows to add various fonts into the document. One can change the font type, size, color etc as per the requirement making the document more attractive and easier to understand.

4. **Footnotes and Cross reference** : Word processors automate the placement of footnotes and enable easy cross-reference of other sections of the document.

5. **Headers and footers** : Headers and footers are typically used in multiple-page documents to display descriptive information. In addition to page numbers, a header or footer can contain information such as: The document name, the date and/or time the document is created or revised, an author name, a graphic, a draft or revision number.

6. **Macros** : In Word, one can automate frequently used tasks by creating and running macros. A macro is a series of commands and instructions that are group together as a single command to accomplish a task automatically.

7. **Layout** : In word processing and desktop publishing, layout refers to the arrangement of text and graphics. The layout of a document can determine which points are emphasized, and whether the document is aesthetically pleasing.

   While no computer program can substitute for a professional layout artist, a powerful desktop publishing system can make it easier to lay out professional-looking documents. WYSIWYG (What you see is what you get) helps layout considerably because it allows to lay out a document on the display screen and see what it will look like when printed.

8. **Spell check**: When it comes to presenting a document to clients, professors or any audience, saying something smart and valuable matters. However, most people are likely to overlook the great content if it is riddled with typos, misspellings and mistakes. Producing flawless copy is a mark of professionalism; most companies expect nothing less in their documentation. One useful tool computer users can employ to edit their documents is a spell checker program or the spell checking functions offered by their word processor.

   Spell check functions or spell checkers are software applications that check words against a digital dictionary to ensure they are spelled correctly. Words that the spell checker identifies as misspelled are typically highlighted or underlined. One main benefit of using a spell checker is its accuracy. Running a spell checker ensures that the number of typos in the document decreases significantly.

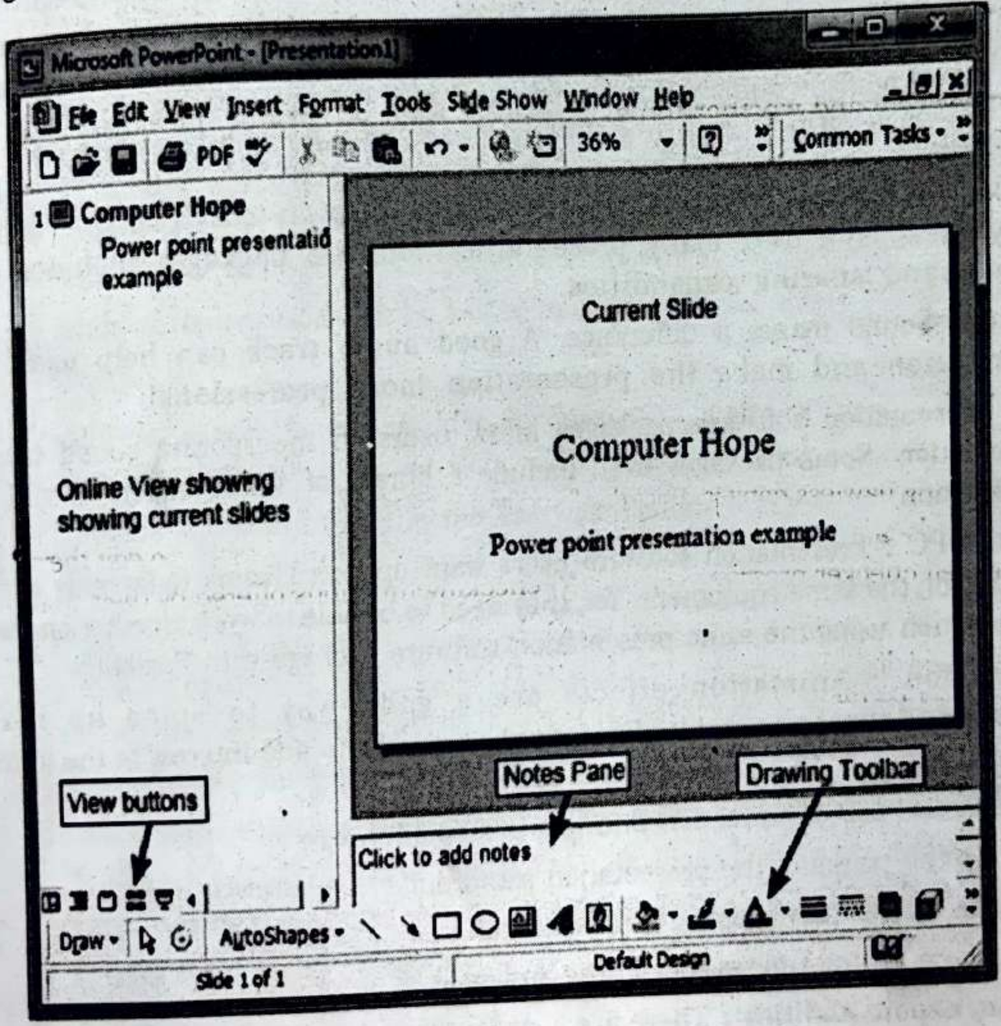
9. **Thesaurus**: Most word processors have in-built thesaurus that allows to search for synonym without leaving the word processor.

10. **Merges**: Merge feature in word processor allows to merge text from one file to another. This is particularly useful for generating many files that have same format but different data. Example includes generating mailing labels.

11. **Table of contents and Indices**: This feature allows the automatic creation of table of contents and index based on special codes that is inserted into the document.

7.2 PRESENTATION SOFTWARE

Presentation software (sometimes called "presentation graphics") is a category of applicationprogram used to create sequences of words and pictures that tell a story or help support a speech or public presentation of information. Presentation software can be divided into business presentation software and more general multimedia authoring tools, with some products having characteristics of both. Business presentation software emphasizes ease- and quickness-of-learning and use. Multimedia authoring software enables to create a more sophisticated presentation that includes audio and video sequences. Business presentation software usually enables one to include images and sometimes audio and video developed with other tools. In other words, a presentation program is a software program that helps create a slideshow that addresses a topic and can be used for various purpose like businesses and schools for discussing a topic or for teaching. Many times, the presenter uses a projector to project the slideshow up on to screen that everyone can see. Below is an example of Microsoft PowerPoint, a commonly used program that creates presentations.


Microsoft PowerPoint - [Presentation1]
File Edit View Insert Format Tools Slide Show Window Help
PDF
36%
Common Tasks
1 Computer Hope
Power point presentatio
example
Current Slide
Computer Hope
Power point presentation example
Online View showing
showing current slides
View buttons
Notes Pane
Drawing Toolbar
Click to add notes
Draw
AutoShapes
Slide 1 of 1
Default Design

Examples of Presentation software

Prezi
Microsoft PowerPoint
Google Slides
Keynote
Zoho Office Suite
Office Sway
WPS Office

7.3 FEATURES OF PRESENTATION SOFTWARE

1. **Real-Time Collaboration** : In today's teamwork-oriented environment, real-time coordination is an important consideration for presentation software. Real-time collaboration allows team members to work together on the same document at the same time.
2. **Creative Design Tools** : Most of the presentation software has a set of creative design tools. .Those tools are used to design a visually attractive creative presentation that'll stand out and capture the audience's attention and interest. This includes the ability to add shapes as well as control the colors used in the presentation.
3. **Mobile Editing** : Clearly, mobile devices are important in today's culture. To be most useful to today's user, many presentation software packages includes mobile editing and sharing capabilities.
4. **Audio** : Sound makes a difference. A good audio track can help users retain information and make the presentation more professional.

   The presentation software packages allow users to incorporate sound into their presentation. Some packages even include a library of sound effects to add to the presentation.
5. **Mac vs PC** : Presentation software users want options. Teams today may not all be working on the same equipment. Yet, they need to be able to work together on the same presentation using the same presentation software package with flexibility.
6. **Animation** : Animation effects are a good way to spice up the presentation. Animation presentation software are used to add interest to the transitions between slides or to add details to a slide.
   - Effective use of animation during a presentation can :
   - help the points of the presentation stand out.
   - pace the delivery process of presentation.
   - make a lasting impression on the audience.
7. **Import/Export Abilities** : There are a wide variety of presentation software program packages available. If one work with presentations, chances are that one will need to import a presentation from another package. Also, one may need to export a presentation for another user.

8. **Online Sharing** : The ability to share a presentation online is important in two regards:

   Online editing tools allow for collaboration.

   Online publishing tools allow to share the presentation on the Web.

9. **Technical Support** : Strong technical support is important for nearly all software packages. Presentation software packages are no different. If one is new to creating presentations or if he/she work with a team that's got varying levels of expertise, be sure to select a presentation software option that offers strong technical support.

10. **Template Availability** : Using a professional template for the presentation can save hours of time. It can also help to create a more effective presentation. Fortunately, many presentation software tools include templates and many templates are available through third parties.

7.4 SPREADSHEETS

An Electronic Spreadsheet or worksheet is like a large sheet of paper ruled-off into columns and rows to form boxes or cells, it is used to store information in the memory of the computer, calculate results and display information and result in a desired manner on the computer screen. In such a worksheet, information is entered through keyboard and displayed on the screen. Data entered in the worksheet can be easily changed and can be used for calculations. If some information (data) is altered, then worksheet will automatically recalculate the results.

All kinds of information can be stored in a spreadsheet. Some common applications are:

- Budgets
- Annual Reports
- Payroll
- Income Statement and Income Tax Calculations
- Inventory Control
- Scientific Calculations
- Invoices or Bills
- Investment and Loan Analysis
- Cost-effective Analysis (using IF-THEN)

The electronic worksheet offers several advantages over the paper spreadsheet

1. It is much faster and easier to make modifications to it and to make both electronic and paper copies of it.
2. It gives result more accurately.
3. It provides several built-in functions which perform complicated problems more rapidly.
4. At a given time one can only see a part of the whole sheet. To see parts which are not visible, we need to 'scroll in' only those parts. It is like seeing the spreadsheet through a window.

5. In addition to allowing numbers and text it allows formulas (such as Contribution Revenue-Variable Cost) to be entered into the worksheet. This enables very rapid recalculation to be done under frequently changed assumptions.
6. It enables to draw various types of graphs to understand the numbers/figures easily.
7. An Electronic worksheet can easily and quickly produce reports and get answers to "what-if' questions e.g., one can instantly determine what the sales target for the last quarter should be if he/she want to increase net profit for the year by 20%.

7.5 MS-EXCEL

The Excel spreadsheet helps to create, view, edit, and share the files with others quickly and easily. It also helps to manage charts, data analyses and more while one view and edit workbooks attached to email messages.

✓ **Microsoft Excel Features :**

1. Create Spreadsheets & Calculate
   - Manage charts, budgets, task lists, accounting, or financial analysis with Excel's modern templates.
   - Use data analysis tools and familiar formulas to run calculations.
   - Rich Office features and formatting options make the workbook easier to read and use.
   - All charts and spreadsheet features, formats, and formulas operate the same way, no matter which device is used.
2. Review and Edit
   - Review the Excel files from any device.
   - Edit charts and data or update the task list from anywhere.
   - Use data analysis features like sort and filter columns to focus the review.
   - Create spreadsheets, duplicate, hide, and unhide easily.
   - Annotate charts with notes, highlight portions of the worksheet, create shapes, or write math equations using ink with the draw tab feature on devices with touch capabilities.
3. Data Analysis
   - Insert charts to bring the data to life.
   - Use data analysis features like add and edit chart labels to highlight key insights.
4. Collaborate and Work Anywhere
   - Share charts and files with a few taps to quickly invite others to edit, view, or leave comments directly in the workbooks.
   - Copy the worksheet in the body of an email message with its format intact or attach or copy a link to the workbook for other sharing options.

7.6 APPLICATION OF MS-EXCEL

1. **Uses of Microsoft Excel in Education :** Teachers can use table styles, shapes, charts, data tools, and formulas to teach students in the classrooms. Students can learn and solve basic and logical-mathematical problems and statistics in excel.

   Teachers can educate by creating a table in Excel sheet. They can highlight more interesting cells in colors, emphasize important values and visualize data using bars and charts.

2. **Uses of Microsoft Excel in Business :** I don't think the business owner, either small or big company can be productive and managed without the use of Microsoft Excel.

   Microsoft Excel application can be used in various business operations. Such as goal setting, budgeting process, and planning, team management, accounts management, income, and expenses calculation, product and service valuation and management of client's data etc. in business.

   The uses of Microsoft Excel in business make such daily official operations faster, accurate and predictable. Because Excel provides great features such as filters, charts, conditional formatting and pivot table, logical and financial formulas. The various uses of Excel in business are as follows:-

   (a) **In Goal Setting and Planning :** Goal setting and planning is a task that all we do repeatedly each day. Goal setting and planning is very important for everyone from students to business owners. But goal setting and planning takes white paper, time and lots of calculation but if one uses Excel then it becomes very easy and environmentally friendly.

   (b) **For Business Owners :** Online business owners or offline can use Excel to manage their daily life work. Such as work progress, team management, pay-outs details, business progress. Such as if one wants to track his/her marketing campaign progress then go to file->new->template and search for a marketing campaign and the output will be pre-designed and formulated cells.

   (c) **ForExpense Calculation :** Excel can be used to manage the daily expenses and can be used to create monthly expenses report.

   (d) **In Daily Progress Report :** Many online and offline companies and clients making it mandatory for virtual and offline staff to maintain their daily progress report. It is not only beneficial for employees but also for companies to track daily progress report. One can create a table with Date, Time, Client, Task, Duration, and status etc. according to demand from clients or manager.

3. **Uses of Microsoft Excel for Data Analysis :** Data analysis is very important to work today for an online business or website owners (eCommerce, blog, forums etc.). Such as from tracking website visitors, products sell, customer reviews, marketing campaigns, user behaviour and events etc. Such work is very time and brain consuming especially when things are not going according to the plan.

Microsoft Excel application provides great benefit for online business owners and customers. Such as by filtering user's data by country, filtering user by age, adding conditional formulas in big data etc. are common daily tasks that can be handled smartly in excel.

REVIEW QUESTIONS

1. What is a word processor? Give its various examples.
2. Explain the several features of word processor
3. What is a presentation software? Give its various examples
4. Explain the several features ofpresentation software
5. What is a Spreadsheet? Give its various examples.
6. Explain the several features of MS-EXCEL.
7. What are the various applications of MS-EXCEL? Explain in detail.

OO

8

CHAPTER

Functions in Excel

LEARNING OUTCOMES

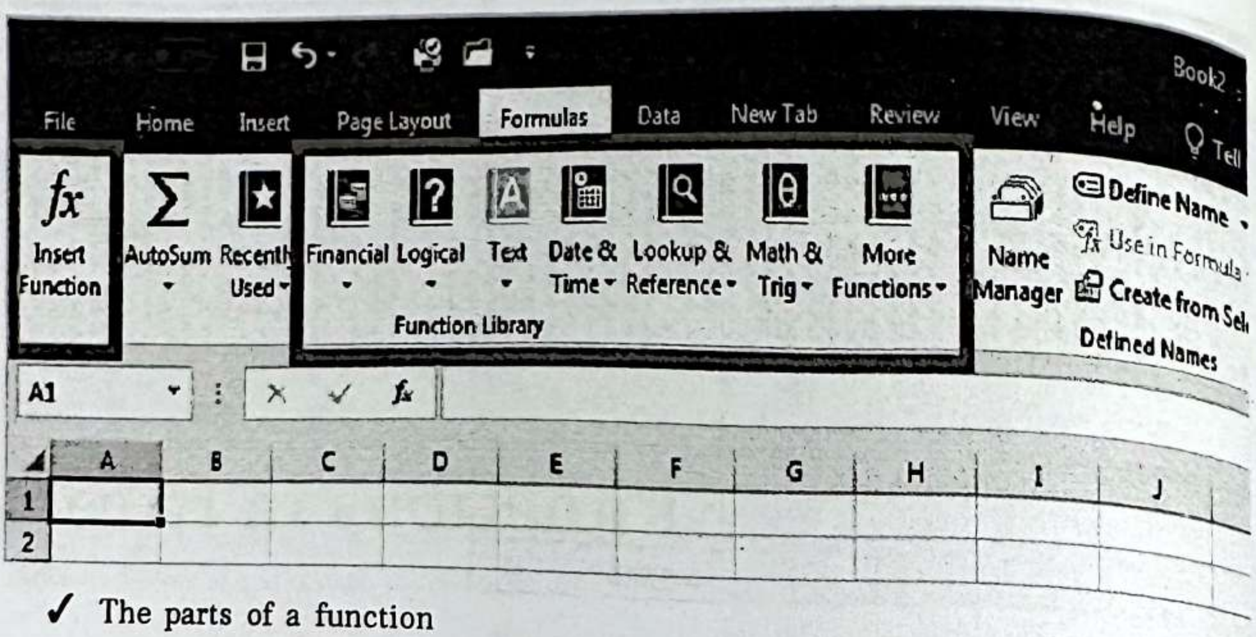
- Creation of Tables in Excel and its formatting
- Creation of Graphs and Charts in EXCEL and its formatting
- Various functions used in EXCEL – Mathematical, Statistical, Financial, Text, Date and Time functions
- Worksheet Management
- Analyze data using Pivot tables
- Creation and management of Scenarios and Summaries

8.0 FUNCTIONS IN EXCEL

A formula is an expression which calculates the value of a cell. Functions are predefined formulas and are already available in Excel. The various Functions available in EXCEL are

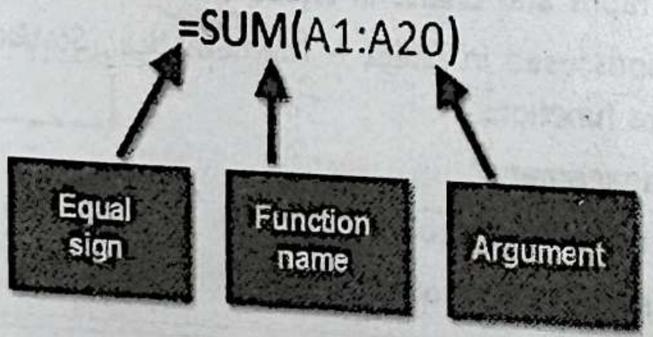
Following are the steps to insert Functions in EXCEL :

1. Click on the Formula Tab
2. Either Click on Insert Function Wizard or Click on the Function to be inserted.


Book2
File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
More Functions
Function Library
Name Manager
Define Name
Use in Formula
Create from Selection
Defined Names
A1
A
B
C
D
E
F
G
H
I
J
1
2

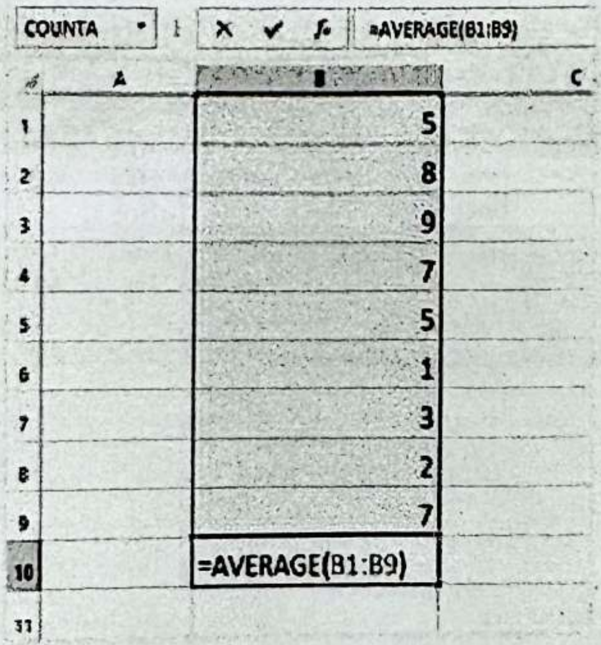
✓ The parts of a function

In order to work correctly, a function must be written a specific way, which is called the syntax. The basic syntax for a function is the equals sign (=), the function name (SUM, for example), and one or more arguments. Arguments contain the information to be calculated. The function in the example below would add the values of the cell range A1:A20.


=SUM(A1:A20)
Equal sign
Function name
Argument

Arguments can refer to both individual cells and cell ranges and must be enclosed within parentheses. one argument or multiple arguments can be included, depending on the syntax required for the function.

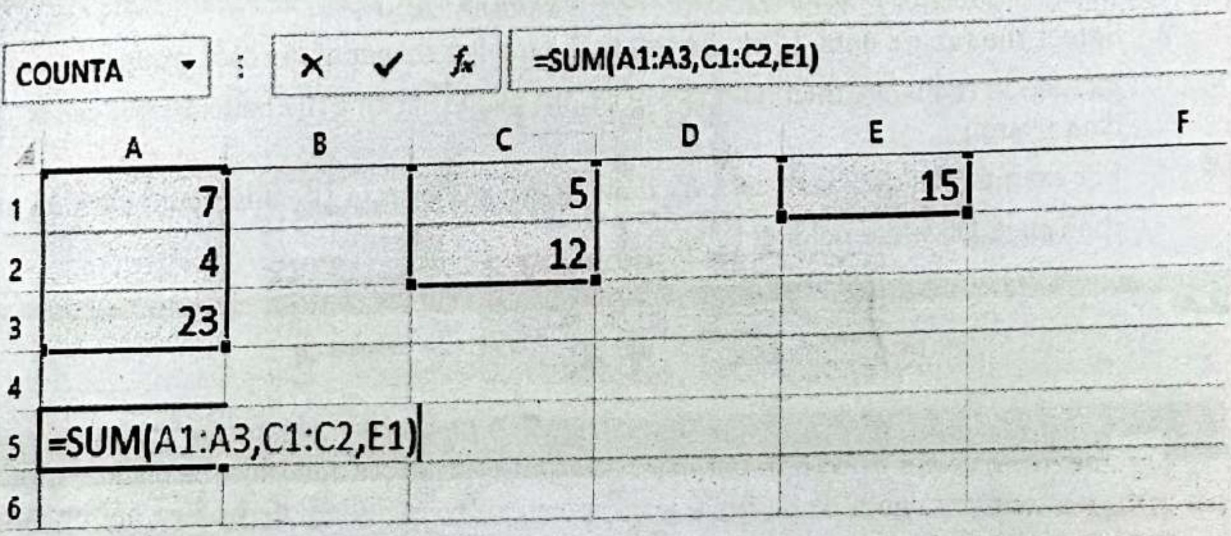
For example, the function =AVERAGE(B1:B9) would calculate the average of the values in the cell range B1:B9. This function contains only one argument.



=AVERAGE(B1:B9)

	A		C
1		5	
2		8	
3		9	
4		7	
5		5	
6		1	
7		3	
8		2	
9		7	
10		=AVERAGE(B1:B9)	
11			

Multiple arguments must be separated by a comma. For example, the function =SUM(A1:A3, C1:C2, E1) will add the values of all the cells in the three arguments.



=SUM(A1:A3,C1:C2,E1)

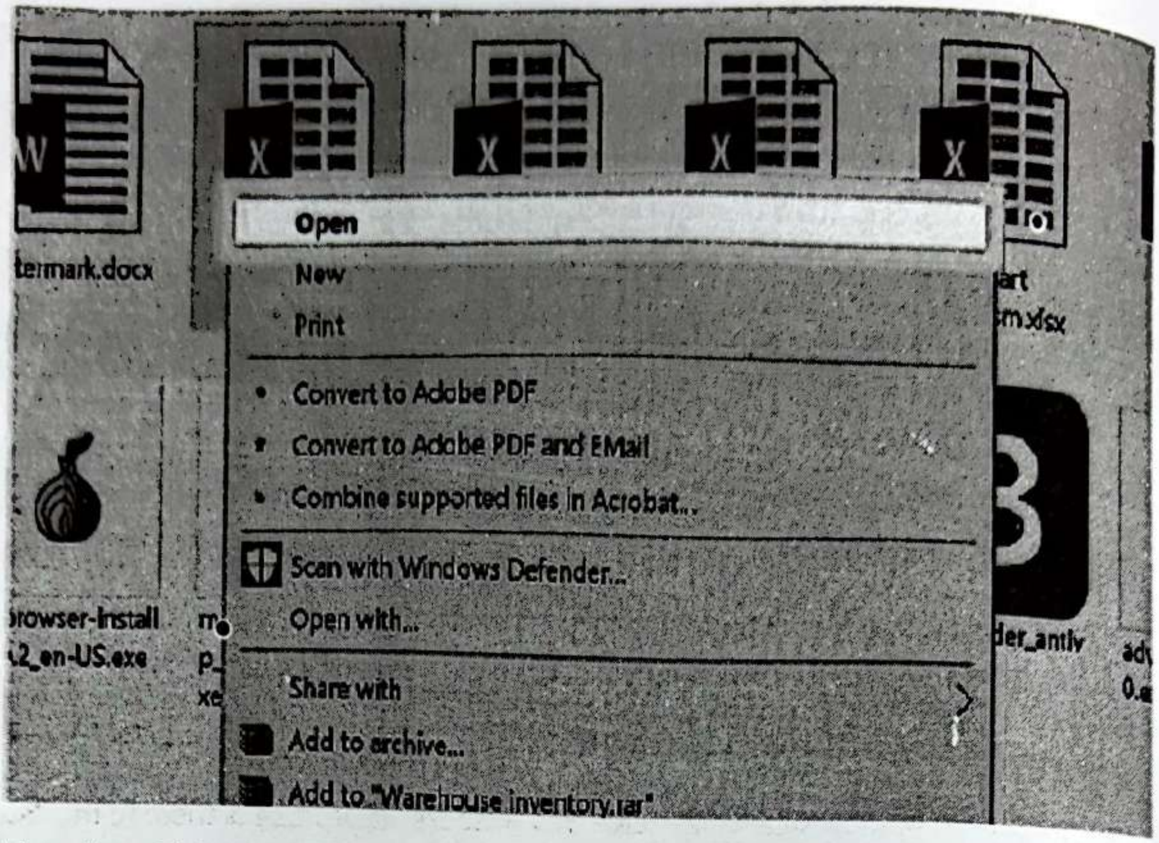
	A	B	C	D	E	F
1	7		5		15	
2	4		12			
3	23					
4						
5	=SUM(A1:A3,C1:C2,E1)					
6						

8.1 TABLES IN EXCEL

8.1.1 Creating Table

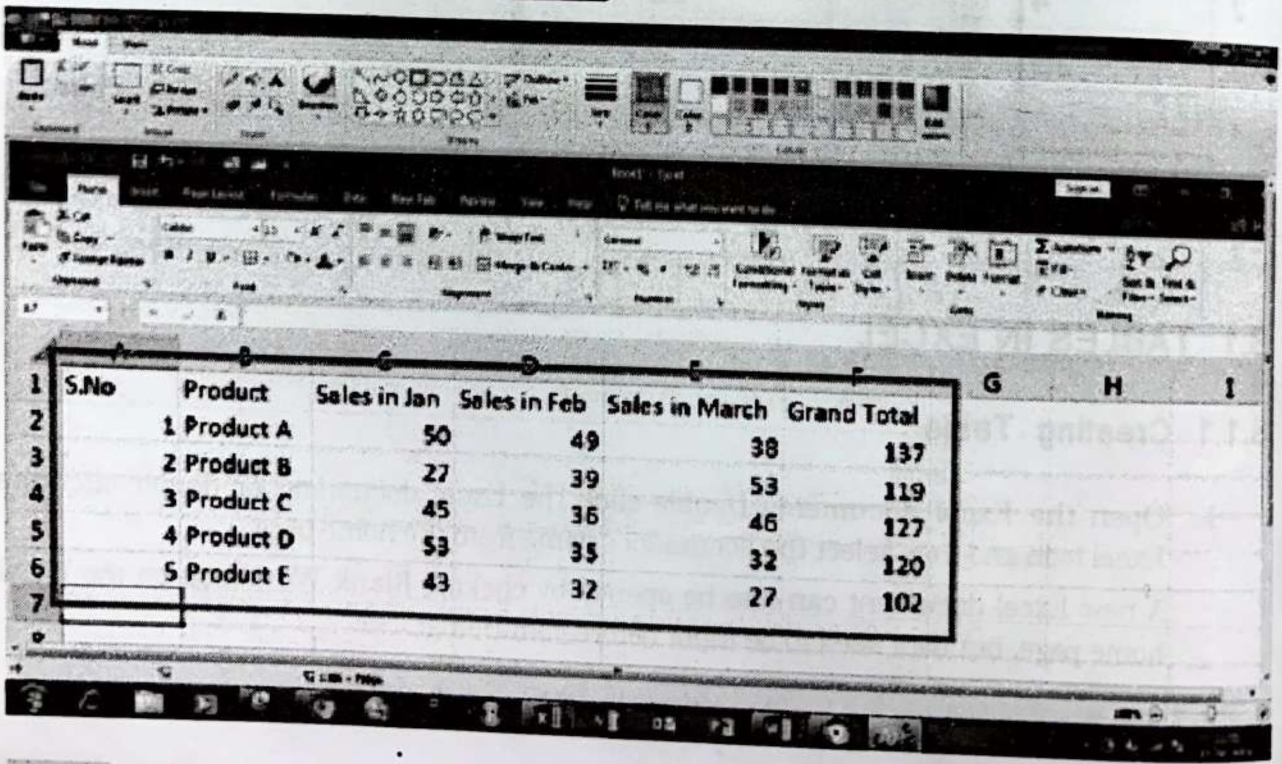
1. Open the Excel document. Double-click the Excel document, or double-click the Excel icon and then select the document's name from the home page.

   A new Excel document can also be opened by clicking **Blank Workbook** on the Excel home page, but data need to be input before continuing.


termark.docx
Open
New
Print
Convert to Adobe PDF
Convert to Adobe PDF and EMail
Combine supported files in Acrobat...
Scan with Windows Defender...
Open with...
Share with
Add to archive...
Add to "Warehouse inventory.rar"
browser-Install
2_en-US.exe
art
m.xlsx
der_antiv

2. Select the table's data. Click the cell in the top-left corner of the data group onewant to include in the table, then hold down ⇧Shift while clicking the bottom-right cell in the data group.

For example : if data is in cells A1 down to A5 and over to D5, one would click A1 and then click D5 while holding ⇧Shift

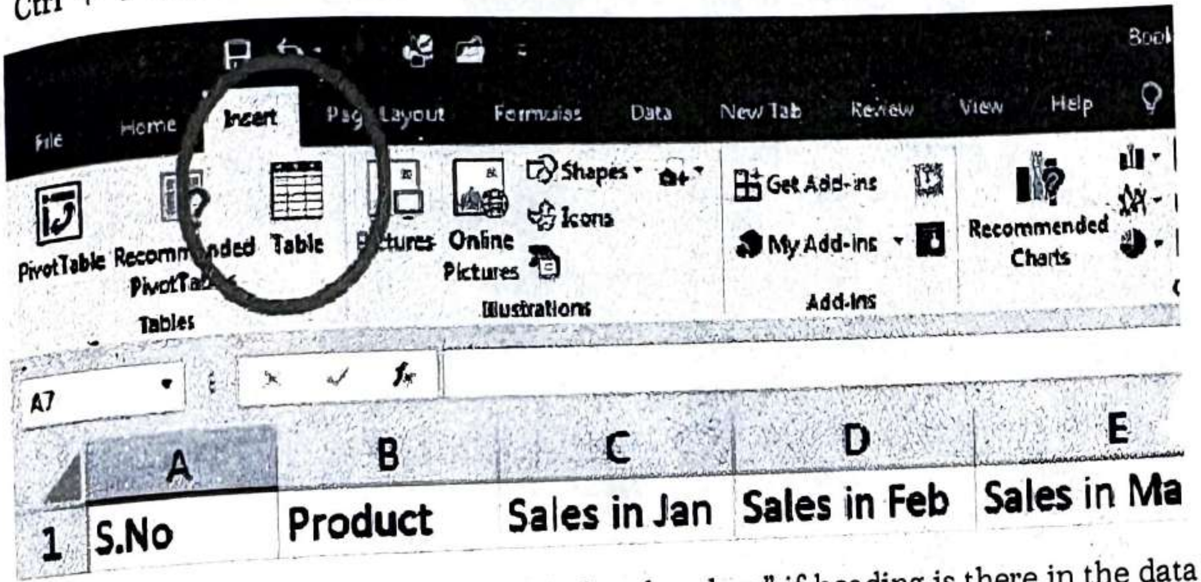


S.No	Product	Sales in Jan	Sales in Feb	Sales in March	Grand Total
	1 Product A	50	49	38	137
	2 Product B	27	39	53	119
	3 Product C	45	36	46	127
	4 Product D	53	35	32	120
	5 Product E	43	32	27	102

3. Select the data and click the **Insert** tab. It's a tab in the green ribbon at the top of the Excel window. Doing so will display the **Insert** toolbar below the green ribbon.

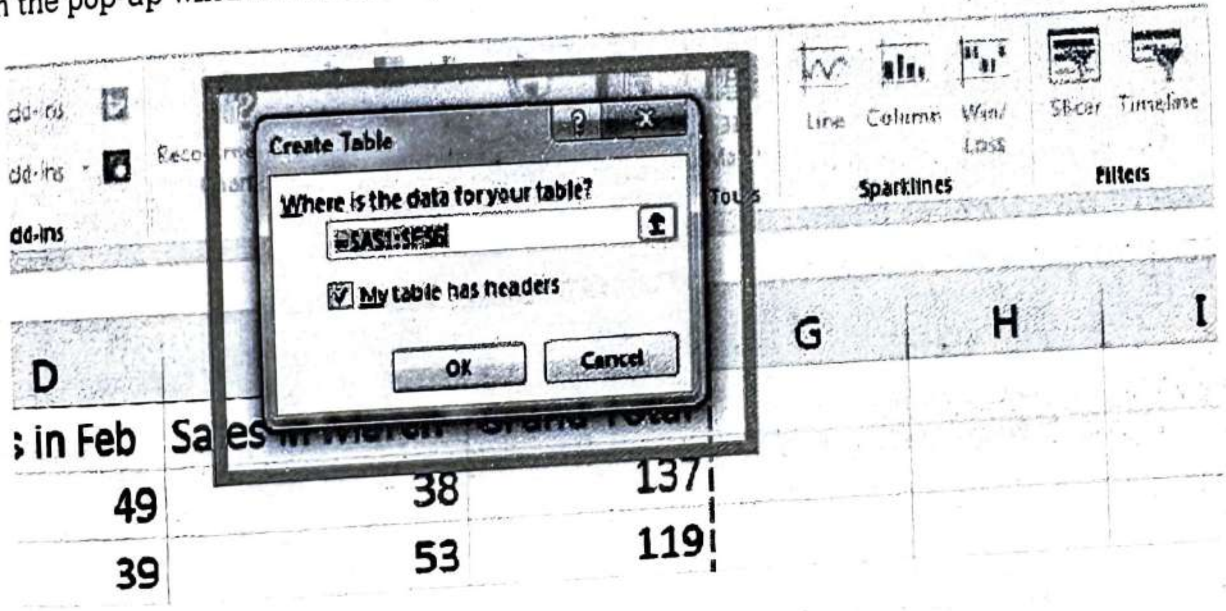
Then Click **Table**. This option is in the "Tables" section of the toolbar. Clicking it brings up a pop-up window.

Ctrl + T can also be used to insert table as a short cut method


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
PivotTable
Recommended PivotTables
Table
Tables
Pictures
Online Pictures
Shapes
Icons
Illustrations
Get Add-ins
My Add-ins
Add-ins
Recommended Charts
A7
A
B
C
D
E

S.No	Product	Sales in Jan	Sales in Feb	Sales in Ma

4. In the pop-up window select "My table has headers" if heading is there in the data file


Add-ins
Line
Column
Win/Loss
Sparklines
Slicer
Timeline
Filters
D
G
H
I
in Feb
Sales in March
Grand Total
49
38
137
39
53
119

Create Table

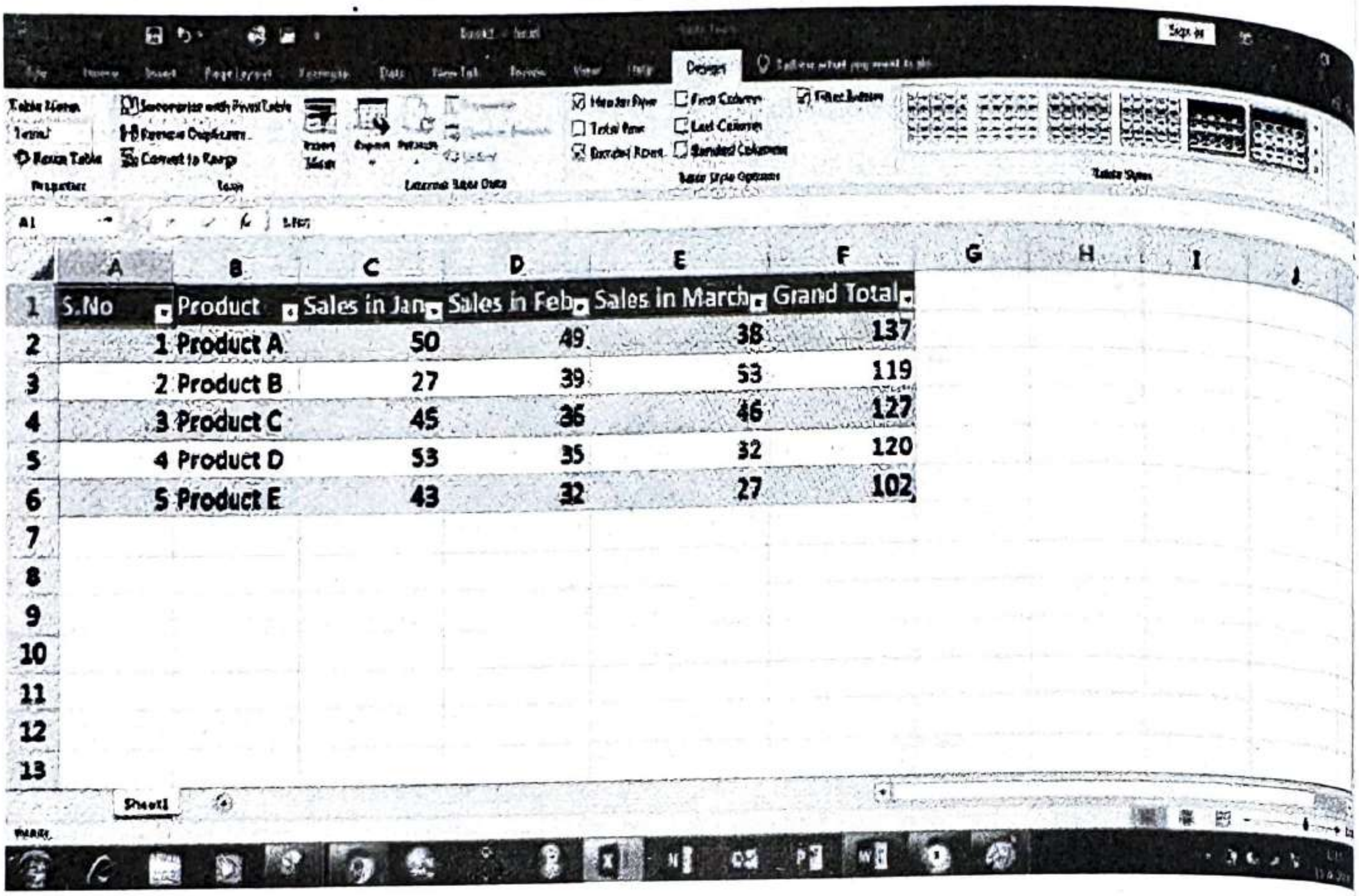
Where is the data for your table?

=$A$1:$F$6

☑ My table has headers

OK Cancel

5. The final table will look like shown below :



S.No	Product	Sales in Jan	Sales in Feb	Sales in March	Grand Total
1	Product A	50	49	38	137
2	Product B	27	39	53	119
3	Product C	45	36	46	127
4	Product D	53	35	32	120
5	Product E	43	32	27	102

8.1.2 Formatting Table Design

1. Click the Design tab. It's in the green ribbon near the top of the Excel window. This wil open a toolbar for the table's design directly below the green ribbon.

   If this tab is not seen, click the table to prompt it to appear.

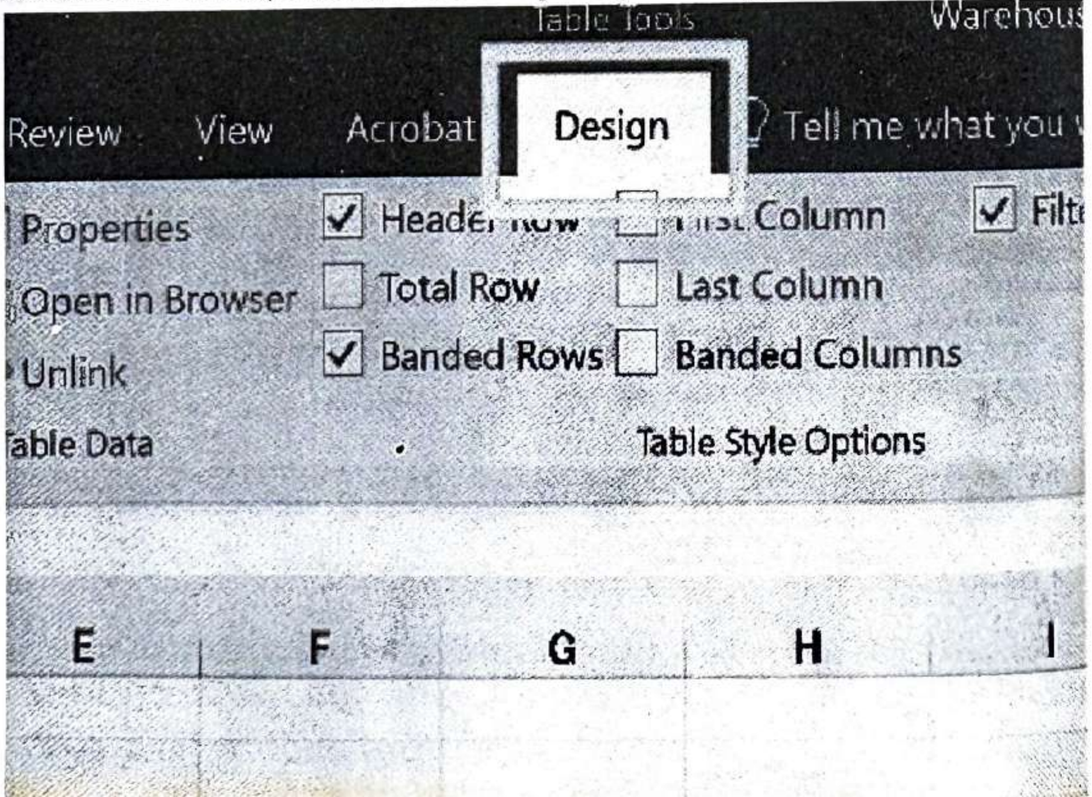


Table Tools
Warehous
Review
View
Acrobat
Design
Tell me what you
Properties
Open in Browser
Unlink
able Data
☑ Header Row
☐ First Column
☑ Filt
☐ Total Row
☐ Last Column
☑ Banded Rows
☐ Banded Columns
Table Style Options
E
F
G
H
I

2. In the Design tab, the various commands are: Properties, Tools, External Table Data, Table Style Options, Table Styles and these are discussed are further.

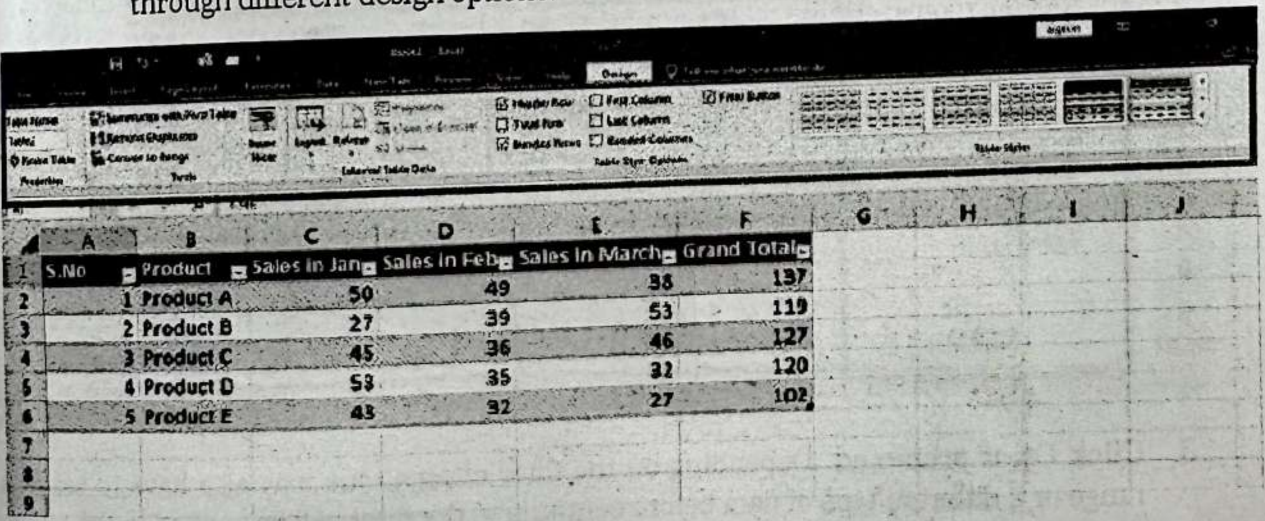
(a) **Properties** : In this the name of the table can be changed by using Table Name command. If more columns or rows are need to be added the Resize Table command will help.

(b) **Table Style Options** : In the "Table Style Options" section of the toolbar, check or uncheck any of the following boxes:

- **Header Row** - Checking this box places column names in the top cell of the data group. Uncheck this box to remove headers
- **Total Row** - When enabled, this option adds a row at the bottom of the table that displays the total value of the right-most column
- **Banded Rows** - Check this box to color in alternating rows or uncheck it to leave all rows in the table the same color.
- **First Column and Last Column** - When enabled, these options make the headers and data in the first and/or last columns bold.
- **Banded Columns** - Check this box to color in alternating columns or uncheck it to leave all columns in the table the same color.
- **Filter Button** - When checked, this box places a drop-down box next to each header in the table that allows one to change the data displayed in that column.

(c) **Table Styles** : Select a design scheme. Click one of the colored boxes in the "Table Styles" section of the Design toolbar to apply the color and design to the table.

One can click the downward-facing arrow to the right of the colored boxes to scroll through different design options.



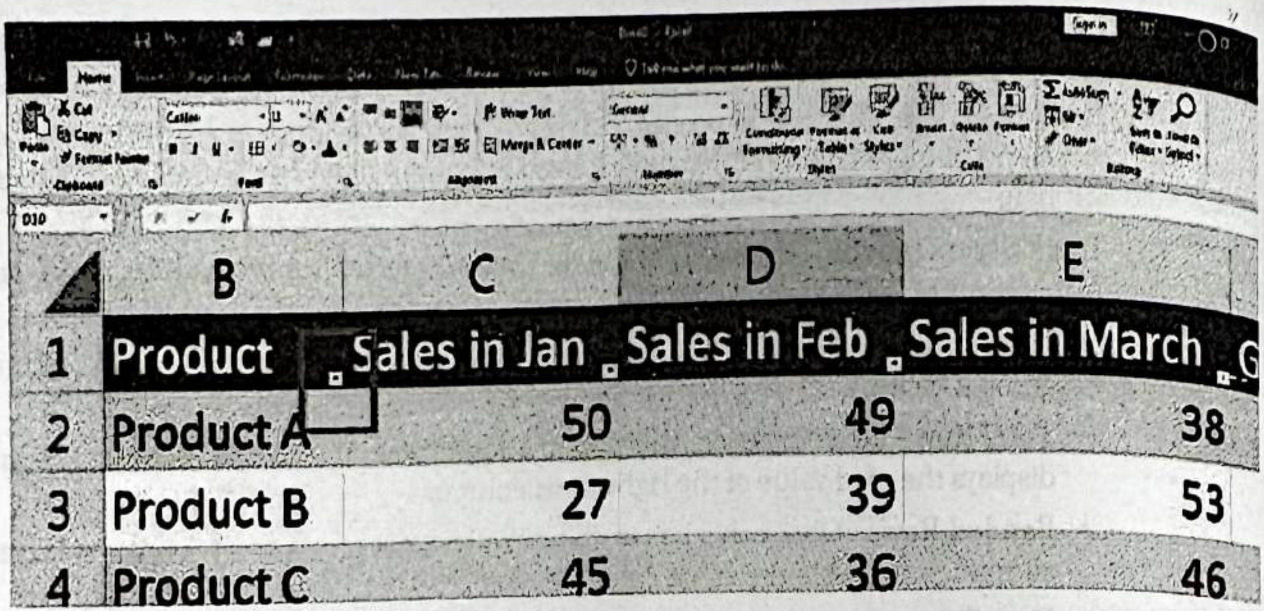
☑ Header Row ☐ First Column ☑ Filter Button
☐ Total Row ☐ Last Column
☑ Banded Rows ☐ Banded Columns

S.No	Product	Sales in Jan	Sales in Feb	Sales in March	Grand Total
1	Product A	50	49	38	137
2	Product B	27	39	53	119
3	Product C	45	36	46	127
4	Product D	53	35	32	120
5	Product E	43	32	27	102

8.1.3 Filtering Table data

1. Open the filter menu. Click the drop-down arrow to the right of the header for the column whose data is to be filtered. A drop-down menu will appear.

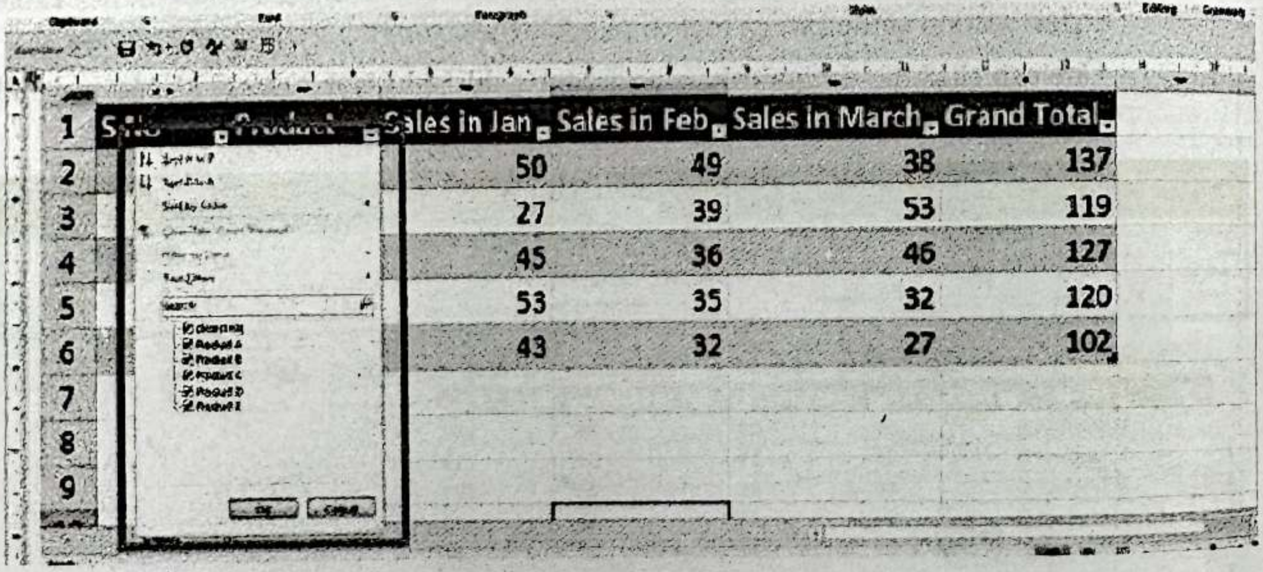
   In order to do this, both the "Header Row" and the "Filter" boxes checked in the "Table Style Options" section of the Design tab.



	B	C	D	E
1	Product	Sales in Jan	Sales in Feb	Sales in March
2	Product A	50	49	38
3	Product B	27	39	53
4	Product C	45	36	46

2. Select a filter. Click one of the following options in the drop-down menu:
    - Sort Smallest to Largest
    - Sort Largest to Smallest

    There are additional options such as Sort by Color or Number Filters depending on the data. If so, one can select one of these options and then click a filter in the pop-out menu.



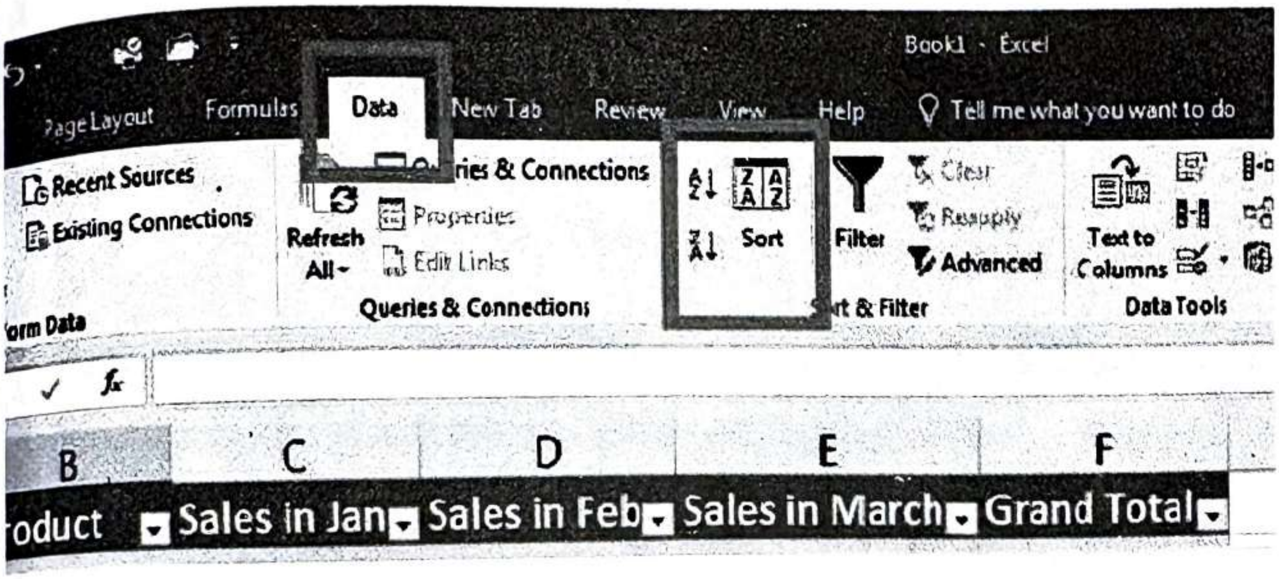
	Product	Sales in Jan	Sales in Feb	Sales in March	Grand Total
2		50	49	38	137
3		27	39	53	119
4		45	36	46	127
5		53	35	32	120
6		43	32	27	102

3. Click OK if prompted. Depending on the filter chosen, one may also have to select a range or a different type of data before continuing. the filter will be applied to the table.

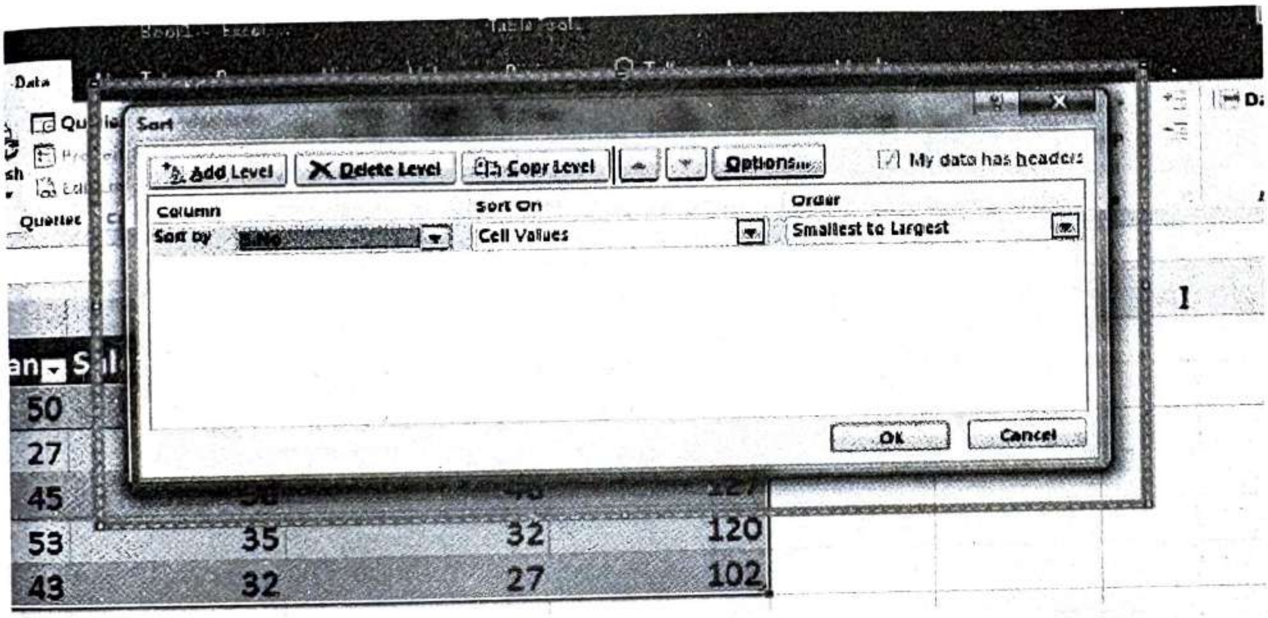
8.1.4 Sorting Table data

1. Select all the cells in the list. This is the safest approach to sorting. In most cases, one can select one cell and Excel will correctly detect the rest of the list -- but it's not 100% certain. Some of the data may be missed.

2. On the Excel Ribbon, click the Data tab.
3. In the Sort & Filter group, click the Sort button.


Book1 - Excel
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell me what you want to do
Recent Sources
Existing Connections
Refresh All
ries & Connections
Properties
Edit Links
Queries & Connections
orm Data
Sort
Filter
Clear
Reapply
Advanced
rt & Filter
Text to Columns
Data Tools
B
C
D
E
F
oduct
Sales in Jan
Sales in Feb
Sales in March
Grand Total

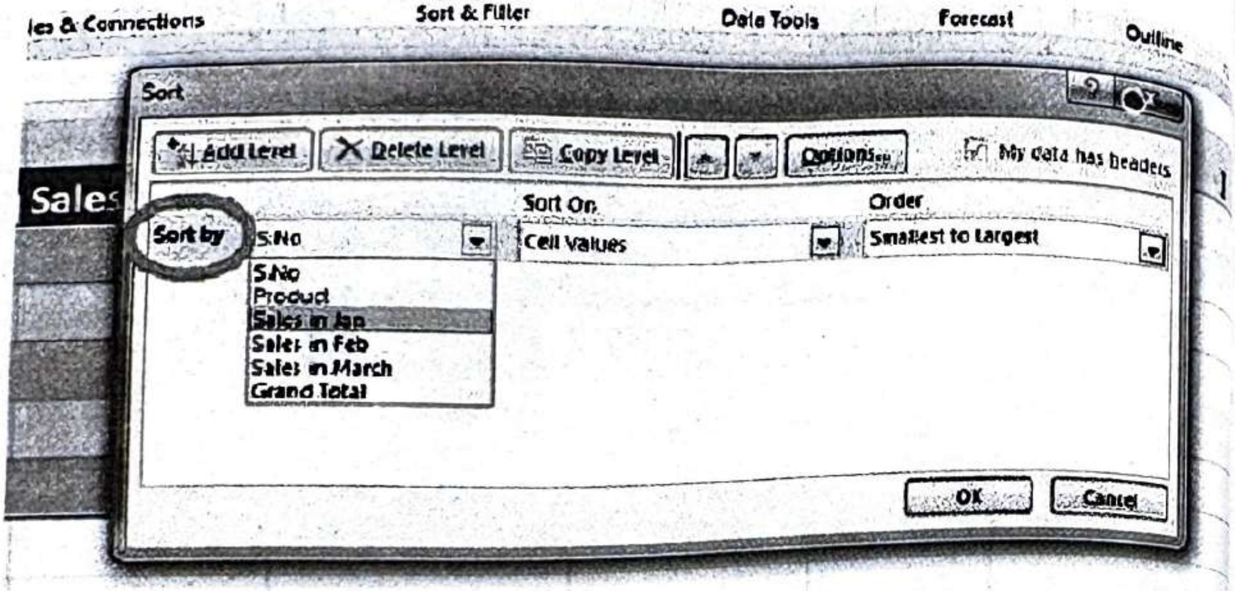
4. A pop-up window will appear showing Column, Sort on, Order


Sort
Add Level
Delete Level
Copy Level
Options...
OK
Cancel
50
27
45
53
43
35
32
32
27
120
102

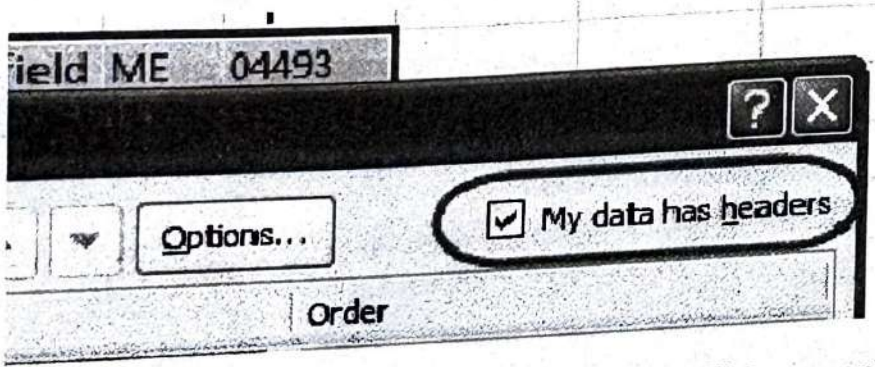
☑ My data has headers

Column	Sort On	Order
Sort by	Cell Values	Smallest to Largest

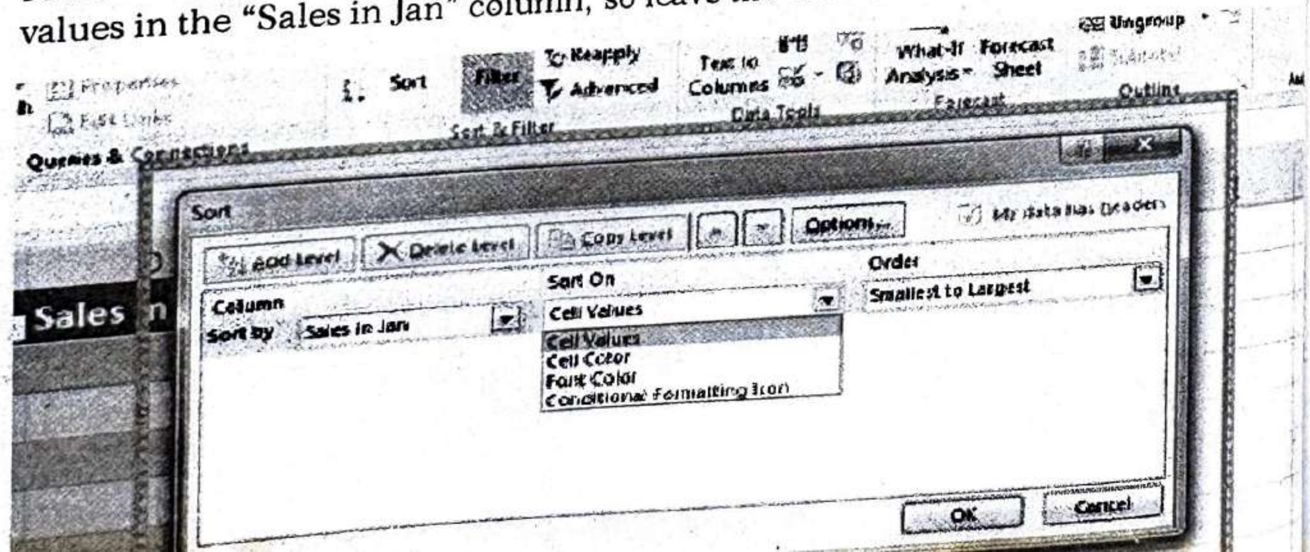
5. From the Sort by dropdown, select the first column to be sorted. In this example, "Sales in Jan" will be the first column sorted.


les & Connections
Sort & Filter
Data Tools
Forecast
Outline
Sort
Add Level
Delete Level
Copy Level
Options...
My data has headers
Sales
Sort by
S.No
Sort On
Cell Values
Order
Smallest to Largest
S.No
Product
Sales in Jan
Sales in Feb
Sales in March
Grand Total
OK
Cancel

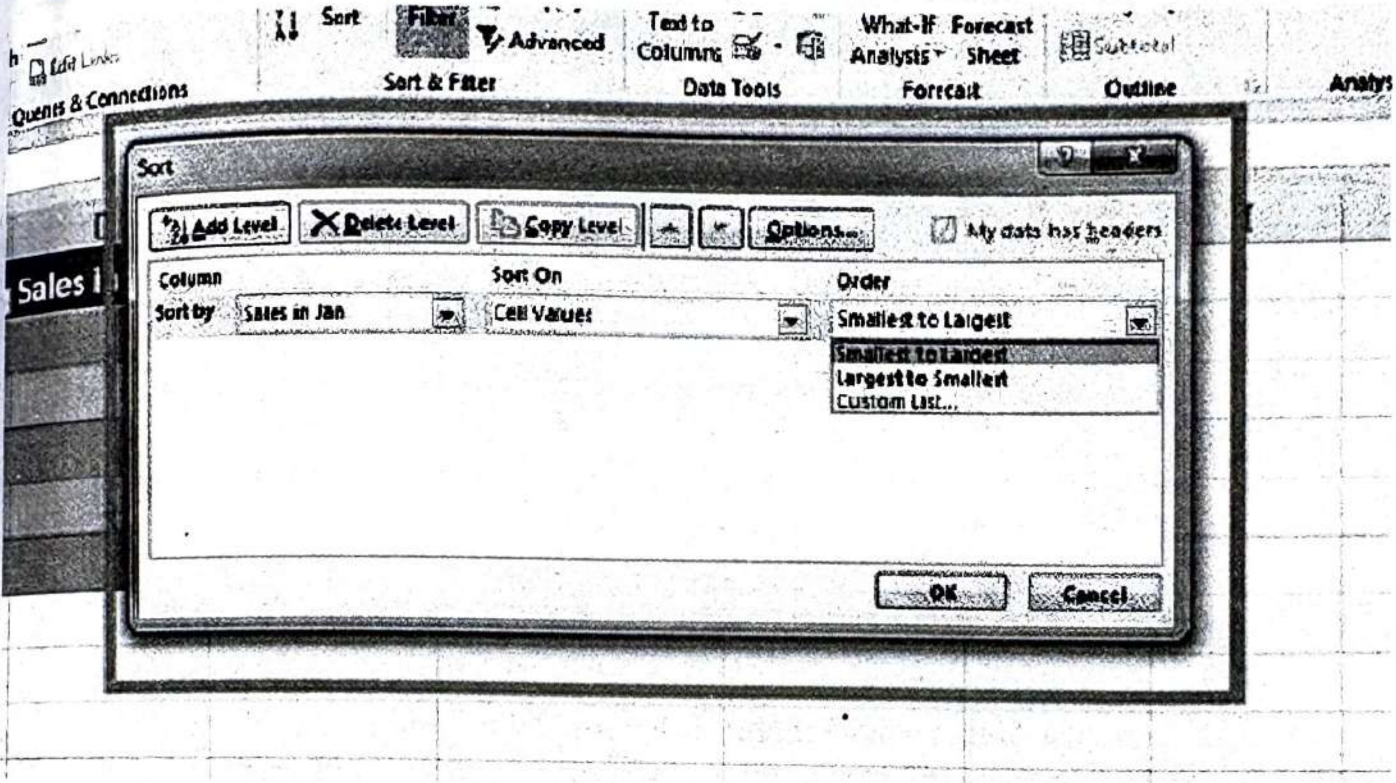
Note: If the dropdown is showing Column letters instead of headings, add a check mark *My data has headers*.


ield ME 04493
?
X
Options...
My data has headers
Order

6. From the Sort On drop down, select the required option. This example is sorting on the values in the "Sales in Jan" column, so leave the default setting of Values.


Properties
Edit Links
Queries & Connections
Sort
Filter
Reapply
Advanced
Sort & Filter
Text to Columns
Data Tools
What-If Analysis
Forecast Sheet
Forecast
Ungroup
Subtotal
Outline
Sort
Add Level
Delete Level
Copy Level
Options...
My data has headers
Sales
Column
Sort by
Sales in Jan
Sort On
Cell Values
Order
Smallest to Largest
Cell Values
Cell Color
Font Color
Conditional Formatting Icon
OK
Cancel

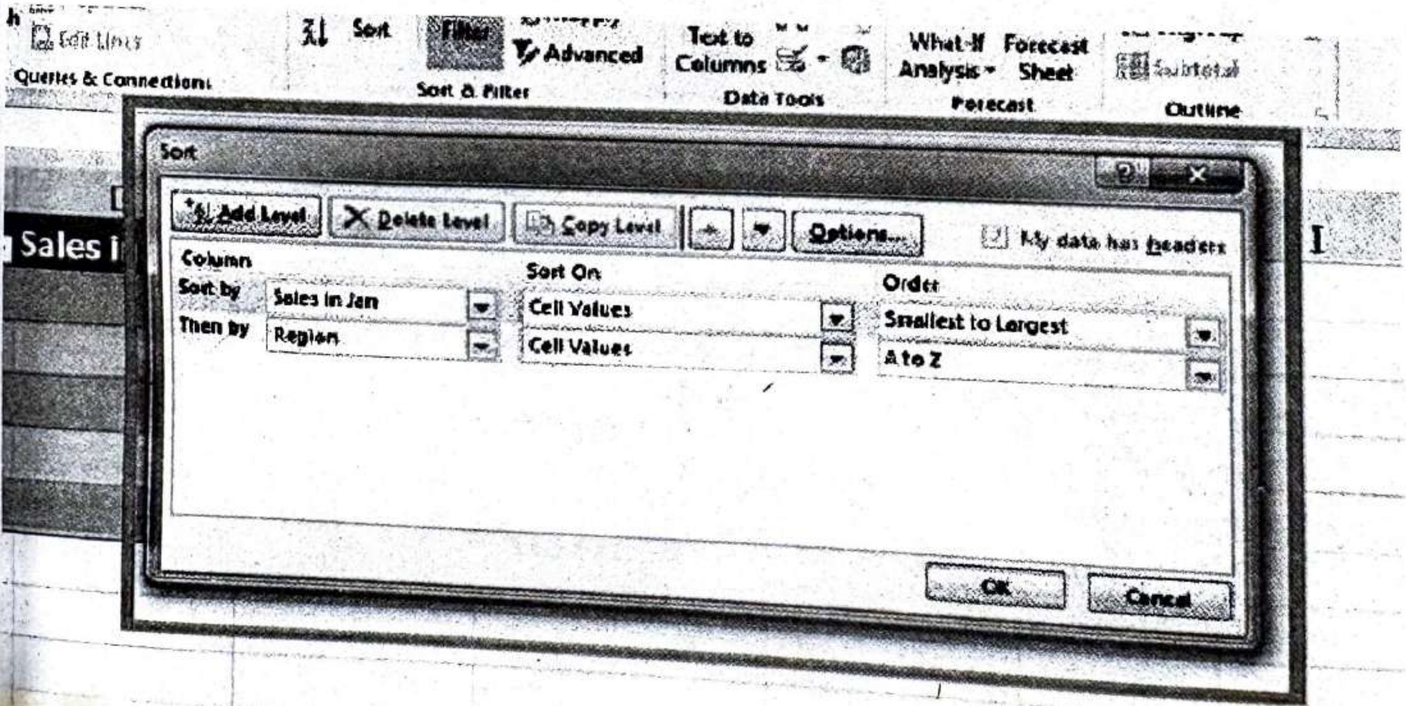
7. Next, from the Order drop down, select one of the options. The list of Order options will depend on what is selected in the Sort On column. Because values are selected in this example and the Order options are Smallest to Largest, Largest to Smallest and Custom List, Smallest to Largest will be selected for further analysis.


Edit Links
Queries & Connections
Sort
Filter
Advanced
Sort & Filter
Text to Columns
Data Tools
What-If Analysis
Forecast Sheet
Forecast
Subtotal
Outline
Analys
Sales i
Sort
Add Level
Delete Level
Copy Level
Options...
My data has headers
Smallest to Largest
Largest to Smallest
Custom List...
OK
Cancel

	Column	Sort On	Order
Sort by	Sales in Jan	Cell Values	Smallest to Largest

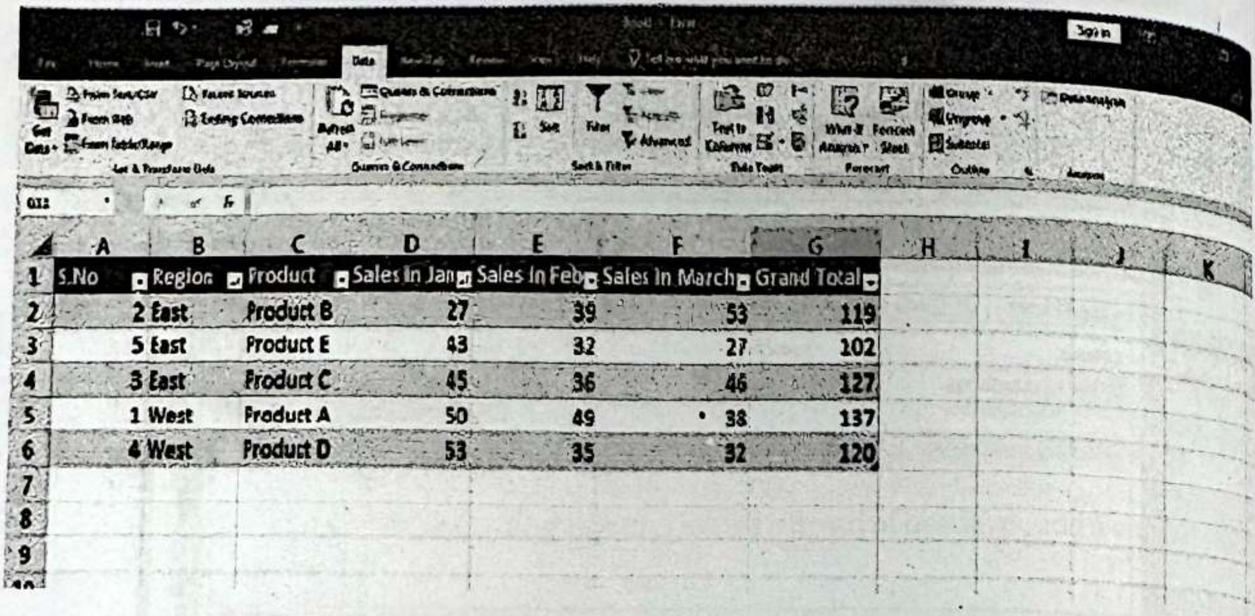
8. If one is sorting on multiple columns, click the Add Level button, to add the next level, and select options from its drop-down boxes.

This examplehave selected “Sales in Jan”, “Region” as the sort fields, and all are sorted on Values. Because the “Sales in Jan” column contains only numbers, its Order options are slightly different from the text column options.


Edit Links
Queries & Connections
Sort
Filter
Advanced
Sort & Filter
Text to Columns
Data Tools
What-If Analysis
Forecast Sheet
Forecast
Subtotal
Outline
Analys
Sales i
Sort
Add Level
Delete Level
Copy Level
Options...
My data has headers
OK
Cancel

	Column	Sort On	Order
Sort by	Sales in Jan	Cell Values	Smallest to Largest
Then by	Region	Cell Values	A to Z

9. After all the Sort levels and their options have been selected, click OK and the final output screen is shown below.

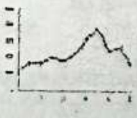


S.No	Region	Product	Sales In Jan	Sales In Feb	Sales In March	Grand Total
	2 East	Product B	27	39	53	119
	5 East	Product E	43	32	27	102
	3 East	Product C	45	36	46	127
	1 West	Product A	50	49	38	137
	4 West	Product D	53	35	32	120

8.2 CHARTS AND GRAPHS

A chart, also known as graph, is a graphical representation of numeric data where the data is represented by symbols such as bars, columns, lines, slices, and so on. Microsoft Excel allows to create a great lot of different graph types such as Column chart, Bar chart, Line chart, Pie chart, Area chart, Bubble chart, Stock, Surface, Radar charts, Pivot Chart etc. Some examples are shown in Figure below :

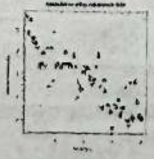
Bar chart



Line chart

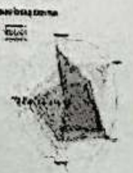
Pie chart

Area chart



Scatter plot

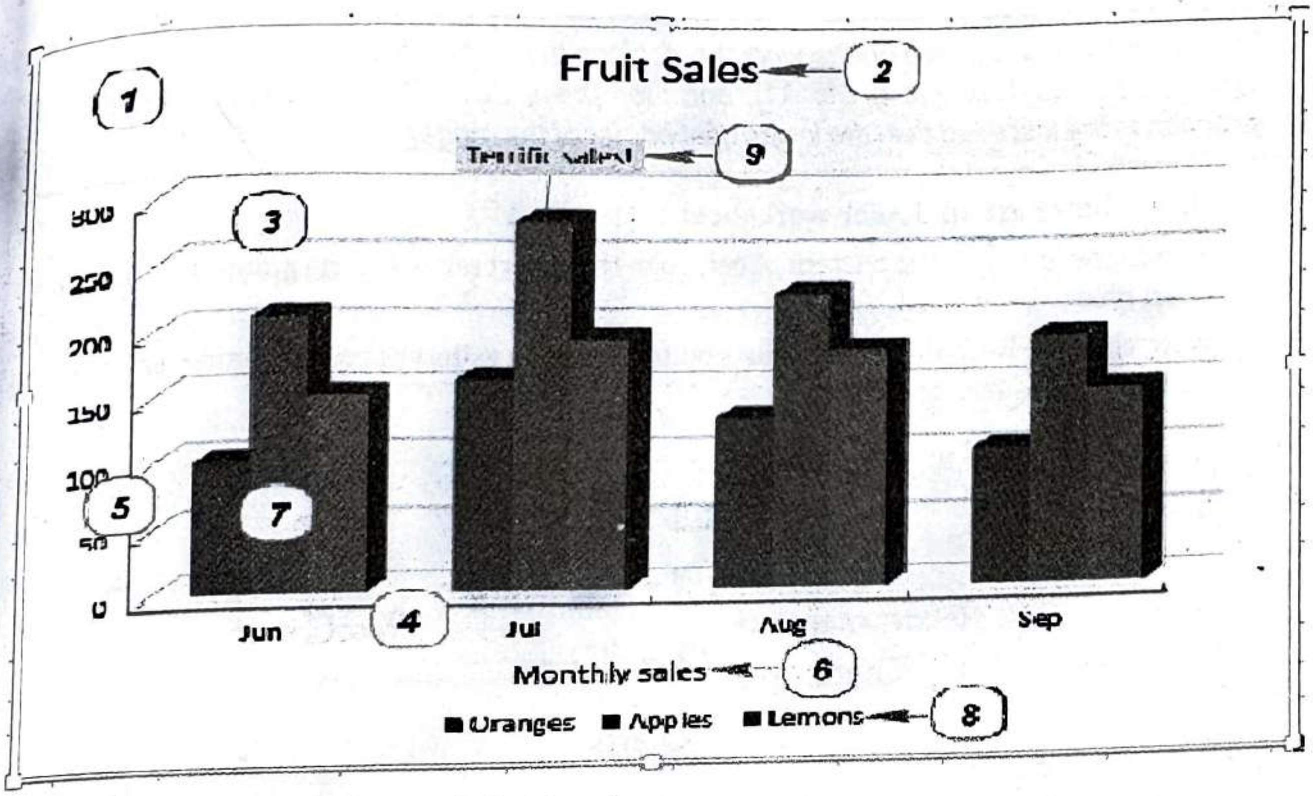
Bubble chart



Radar chart

Excel charts have a handful of elements. Some of these elements are displayed by default, others can be added and modified manually as needed.

1. Chart area
2. Chart title
3. Plot area
4. Horizontal (category) axis
5. Vertical (value) axis
6. Axis title
7. Data points of the data series
8. Chart legend
9. Data label

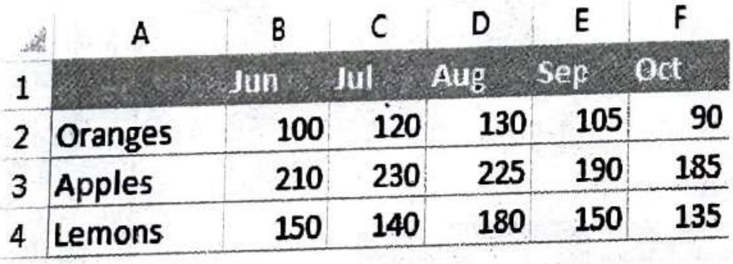


8.2.1 How to make a graph in Excel

Graphs can be created in EXCEL from a variety of chart types to present the data in the most meaningful way. Combination charts can also be prepared by using several chart types.

To create a chart in Excel, start by entering the numeric data on a worksheet, and then continue with the following steps.

1. Select data to include in the chart



	A	B	C	D	E	F
1		Jun	Jul	Aug	Sep	Oct
2	Oranges	100	120	130	105	90
3	Apples	210	230	225	190	185
4	Lemons	150	140	180	150	135

Assuming that the data shown above has already been prepared, select all the data to be included in Excel graph. Select the column headings they are needto be appeared either in the chart legend or axis labels.

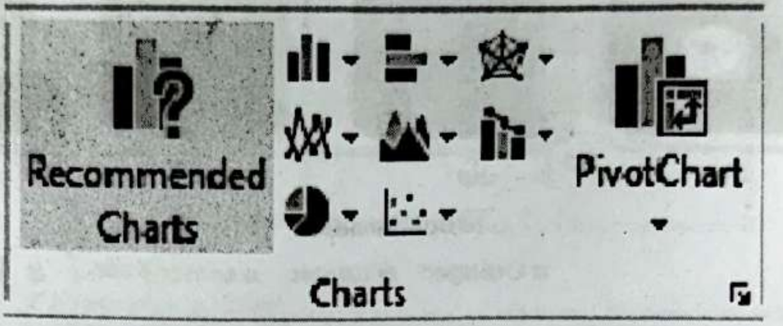
- If one wants to make a chart based on adjacent cells, one can select only one cell, and Excel will automatically include all contiguous cells that contain data.
- To create a graph based on the data in non-adjacent cells, select the first cell or a range of cells, hold down the CTRL key and select other cells or ranges. (Please note, one can plot non-adjacent cells or ranges in a chart only if the selection forms a rectangle).

Tip. To select all used cells on the worksheet, place the cursor in the first cell of the used range (press Ctrl+Home to get to A1), and then press Ctrl + Shift + End to extend the selection to the last used cell (the lower-right corner of the range).

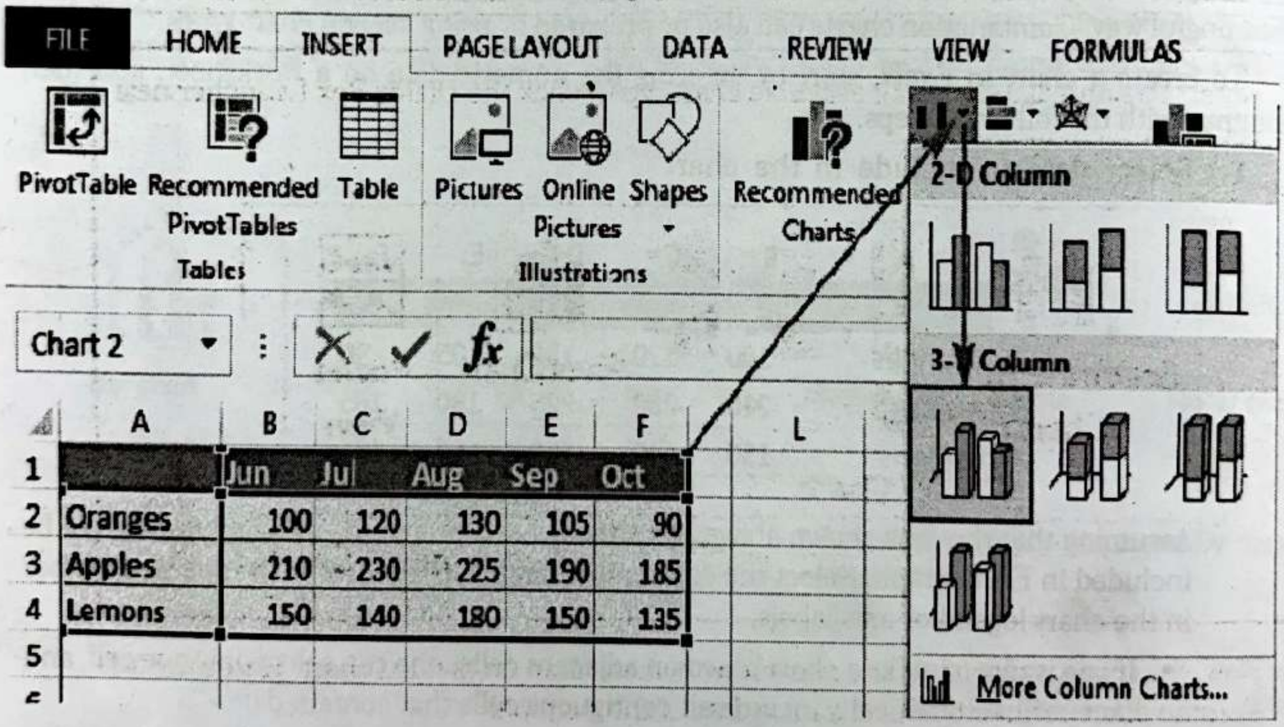
2. **Inset the chart in Excel worksheet**

   To add the graph on the current sheet, go to the Insert tab > Charts group, and click on a chart type to be created.

   Now, click the Recommended Charts button to view a gallery of pre-configured graphs that best match the selected data.

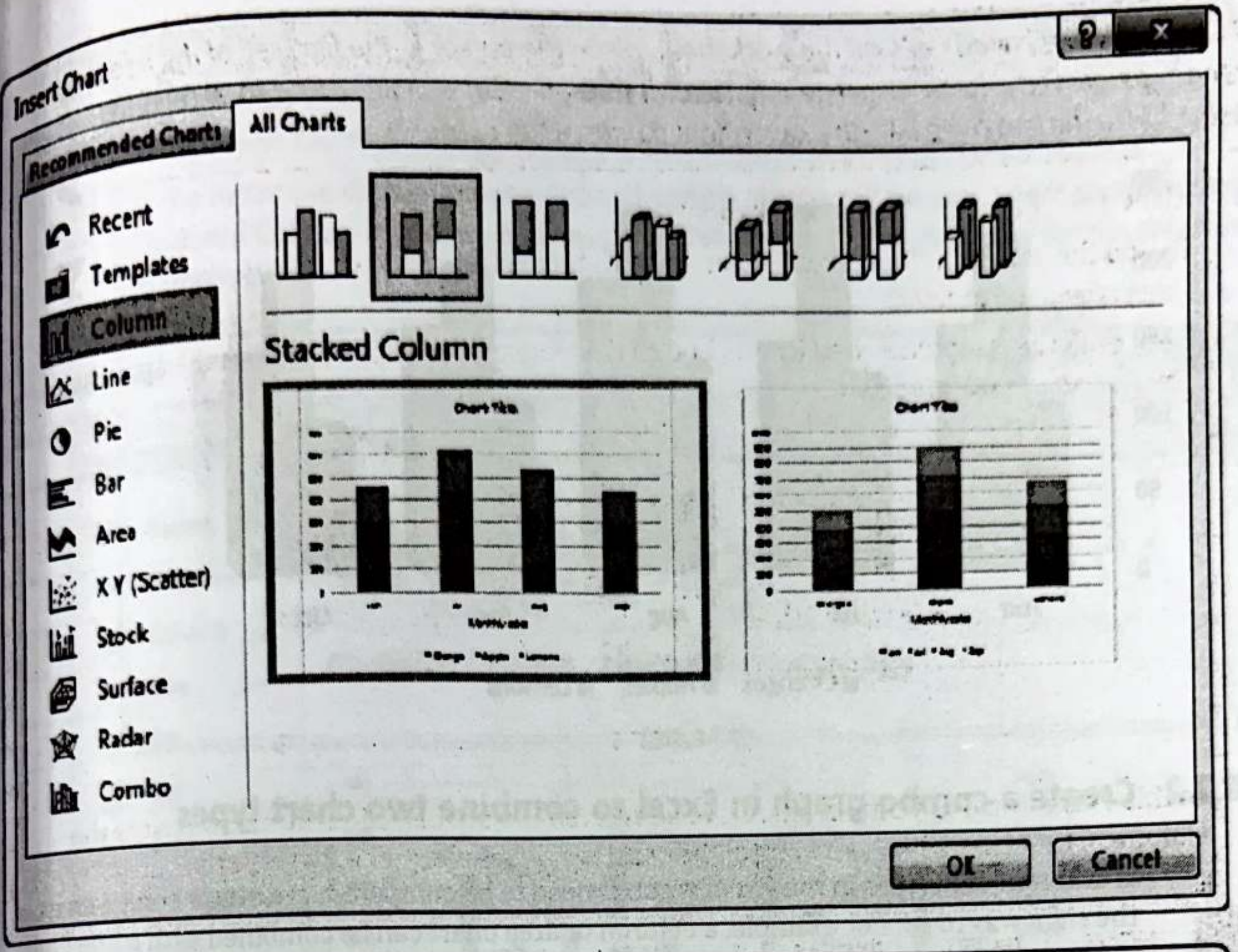

Recommended Charts
PivotChart
Charts

In this example a 3-D Column chart is to be created. To do this, click the arrow next to the Column Chart icon and choose one of the chart sub-types under the 3-D Column category.

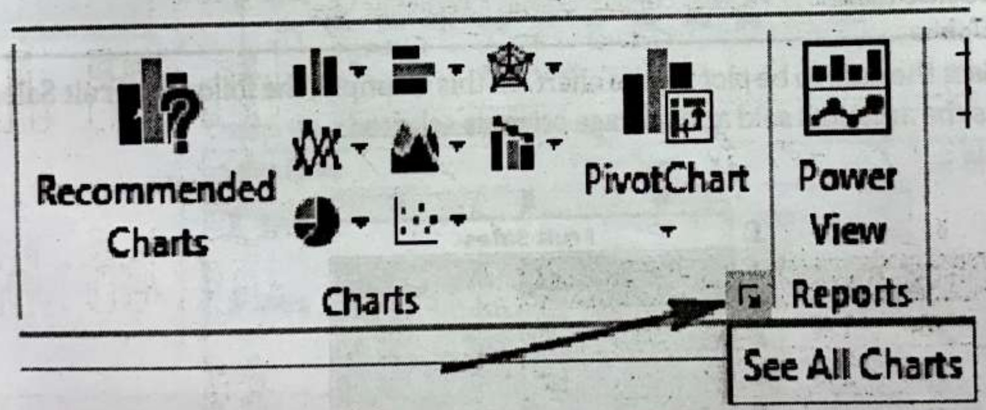

FILE
HOME
INSERT
PAGE LAYOUT
DATA
REVIEW
VIEW
FORMULAS
PivotTable
Recommended PivotTables
Table
Tables
Pictures
Online Pictures
Shapes
Illustrations
Recommended Charts
Chart 2
fx
2-D Column
3-D Column
More Column Charts...

	A	B	C	D	E	F
1		Jun	Jul	Aug	Sep	Oct
2	Oranges	100	120	130	105	90
3	Apples	210	230	225	190	185
4	Lemons	150	140	180	150	135

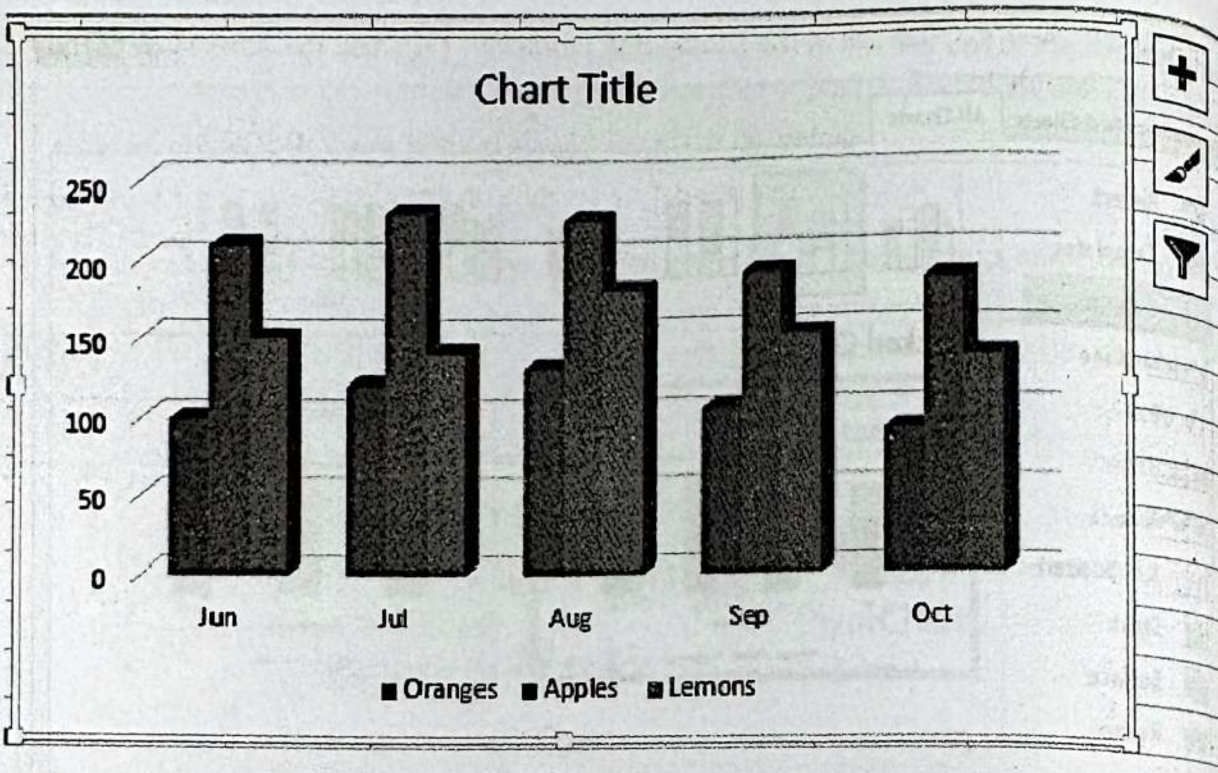
For more chart types, click the More Column Charts… link at the bottom. The Insert Chart dialog window will open, and a list of available column chart sub-types will be seen at the top. Other graph types can also be chosen on the left-hand side of the dialog.


Insert Chart
Recommended Charts
All Charts
Recent
Templates
Column
Line
Pie
Bar
Area
X Y (Scatter)
Stock
Surface
Radar
Combo
Stacked Column
OK
Cancel

Note: To immediately see all available chart types, click the Dialog Box Launcher next to Charts.


Recommended Charts
PivotChart
Power View
Charts
Reports
See All Charts

Now, the graph is placed on the current worksheet as an embedded chart. Here's the 3-D Column chart created by Excel for the data of the example:

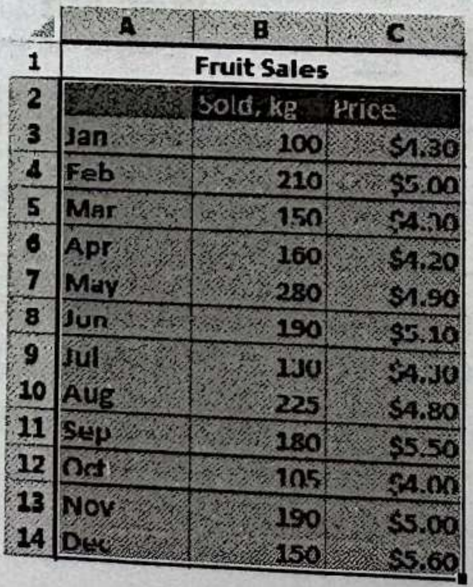


8.2.2 Create a combo graph in Excel to combine two chart types

If different data types in the Excel graph is need to be compared, creating a combo chart is the right way to go. For example, a column or area chart can be combined with a line chart to present dissimilar data, for example an overall revenue and the number of items sold.

> *NOTE: In Microsoft Excel 2010 and earlier versions, creating a combination chart was a cumbersome task.*

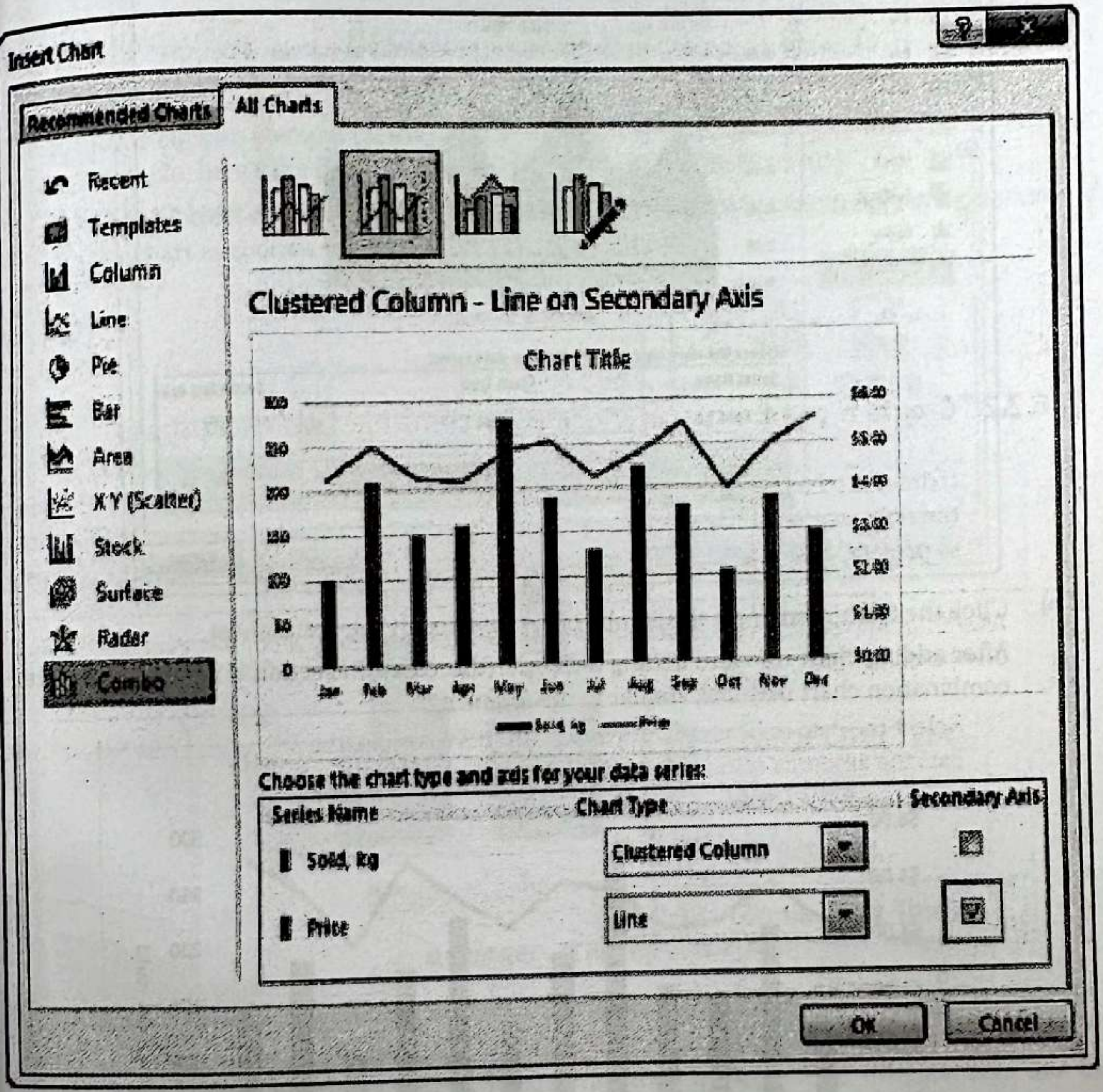
1. Select the data to be plot for the chart. In this example, the following Fruit Sales table that lists the amounts sold and average prices is selected.



	A	B	C
1		Fruit Sales	
2		Sold, kg	Price
3	Jan	100	$4.30
4	Feb	210	$5.00
5	Mar	150	$4.10
6	Apr	160	$4.20
7	May	280	$4.90
8	Jun	190	$5.10
9	Jul	130	$4.30
10	Aug	225	$4.80
11	Sep	180	$5.50
12	Oct	105	$4.00
13	Nov	190	$5.00
14	Dec	150	$5.60

2. On the *Insert* tab, click the *Dialog Box Launcher* ⬚ next to *Charts* to open the *Insert Chart* dialog.
3. In the *Insert Chart* dialog, go to the *All Charts* tab and select the Combo category.

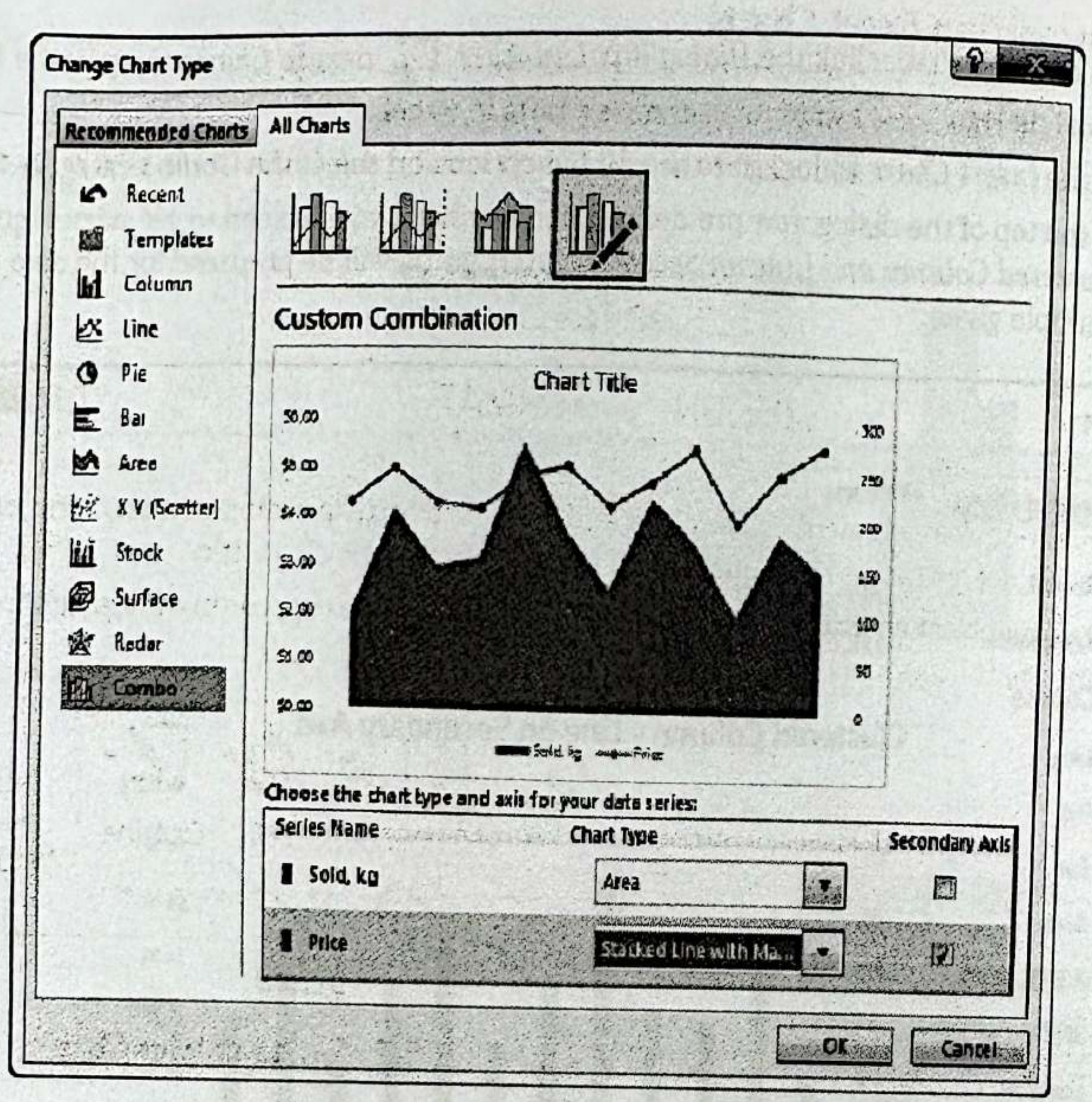
   At the top of the dialog, few pre-defined combo charts will be seen to get started quickly. *Clustered Column and Line on Secondary Axis* graph will be prepared for the data of the example given.


Insert Chart
Recommended Charts
All Charts
Recent
Templates
Column
Line
Pie
Bar
Area
X Y (Scatter)
Stock
Surface
Radar
Combo
Clustered Column - Line on Secondary Axis
Chart Title
300
250
200
150
100
50
0
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Sold, kg
Price
OK
Cancel

Choose the chart type and axis for your data series:

Series Name	Chart Type	Secondary Axis
Sold, kg	Clustered Column	☐
Price	Line	☑

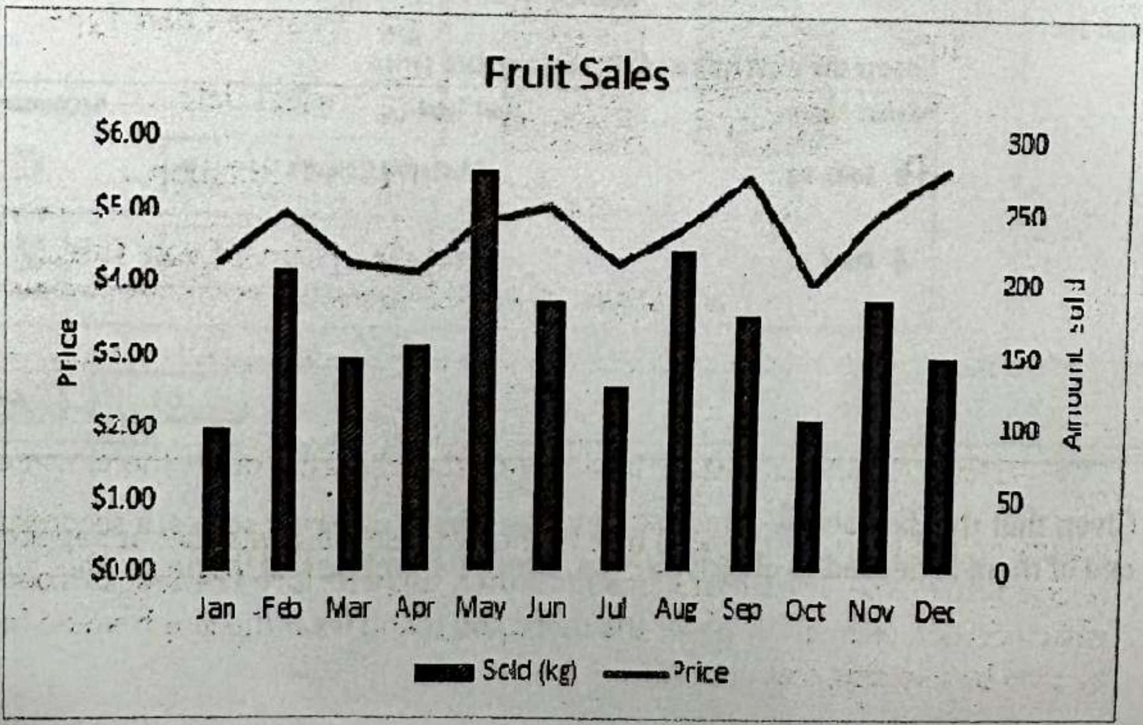
Given that the data series (Amount and Price) have different scales, a secondary axis in one of them is needed to clearly see the values for both series in the graph.


Change Chart Type
Recommended Charts
All Charts
Recent
Templates
Column
Line
Pie
Bar
Area
X Y (Scatter)
Stock
Surface
Radar
Combo
Custom Combination
Chart Title
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
300
250
200
150
100
50
0
Sold, kg
Price
OK
Cancel

Choose the chart type and axis for your data series:

Series Name	Chart Type	Secondary Axis
Sold, kg	Area	☐
Price	Stacked Line with Ma...	☑

4. Click the OK button to get the combo chart inserted in the Excel sheet.
   After adding chart title and adding axis title (discussed in section 8.2.3) the completed combination chart may look similar to the following:



8.2.3 Customizing Excel Charts

Overall, there are 3 ways to customize charts in Excel.

1. Select the chart and look for the needed options on the Chart Tools tabs on the Excel ribbon.

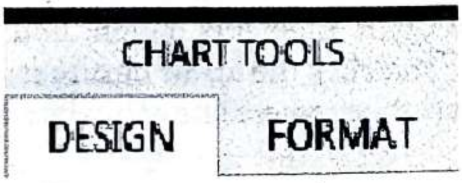
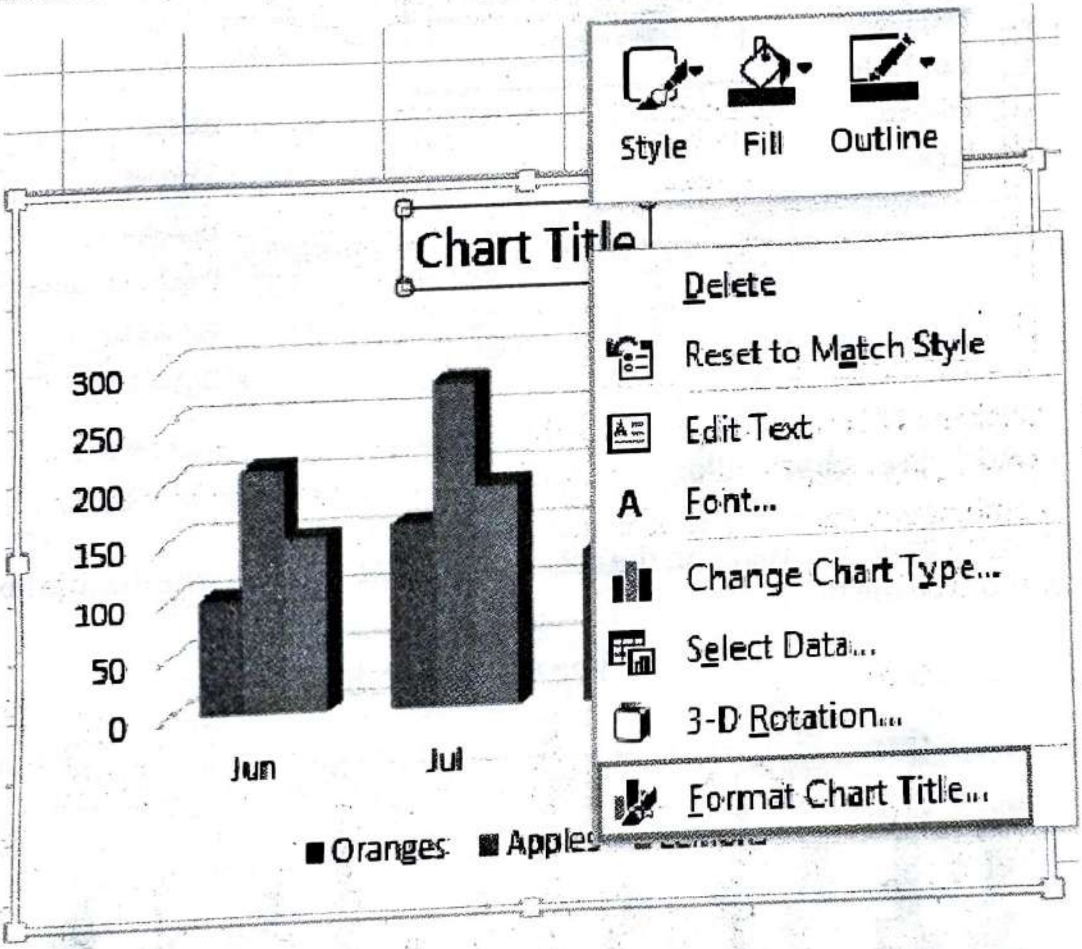


CHART TOOLS
DESIGN
FORMAT

2. Right-click an element on the chart and select the corresponding context menu item. For example, here's the right-click menu for customizing the chart title:
3. Use on-object chart customization buttons. These buttons appear in the top right corner of the chart as soon as oneclick on it.


Style
Fill
Outline
Chart Title
Delete
Reset to Match Style
Edit Text
Font...
Change Chart Type...
Select Data...
3-D Rotation...
Format Chart Title...
300
250
200
150
100
50
0
Jun
Jul
■ Oranges
■ Apples

✚ **Chart Elements** button. It launches the checklist of all the elements one can modify or add to the graph, and it only shows those elements that are applicable to the selected chart type. The Chart Elements button supports Live Preview, so if one is not sure what a certain element is, hover the mouse on it and what the graph would look like will be seen by selecting that option.

Chart Styles button. It lets quickly change the chart styles and colors.

Chart Filters button. It allows to show or hide data displayed in the chart.

For more options, click the Chart Elements button, find the element to be added or customized in the checklist, and click the arrow next to it. The Format Chart pane will appear on the right of the worksheet, where one can select the required options:

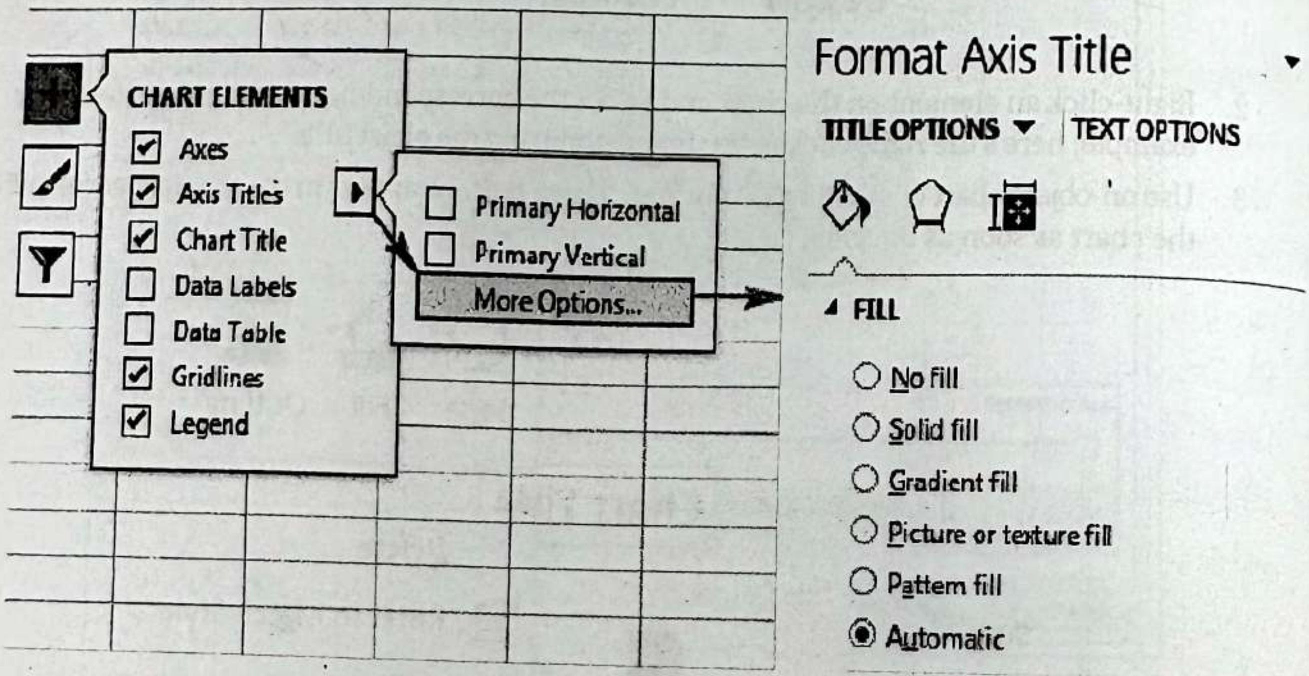


CHART ELEMENTS
Format Axis Title
TITLE OPTIONS
TEXT OPTIONS
FILL
More Options...

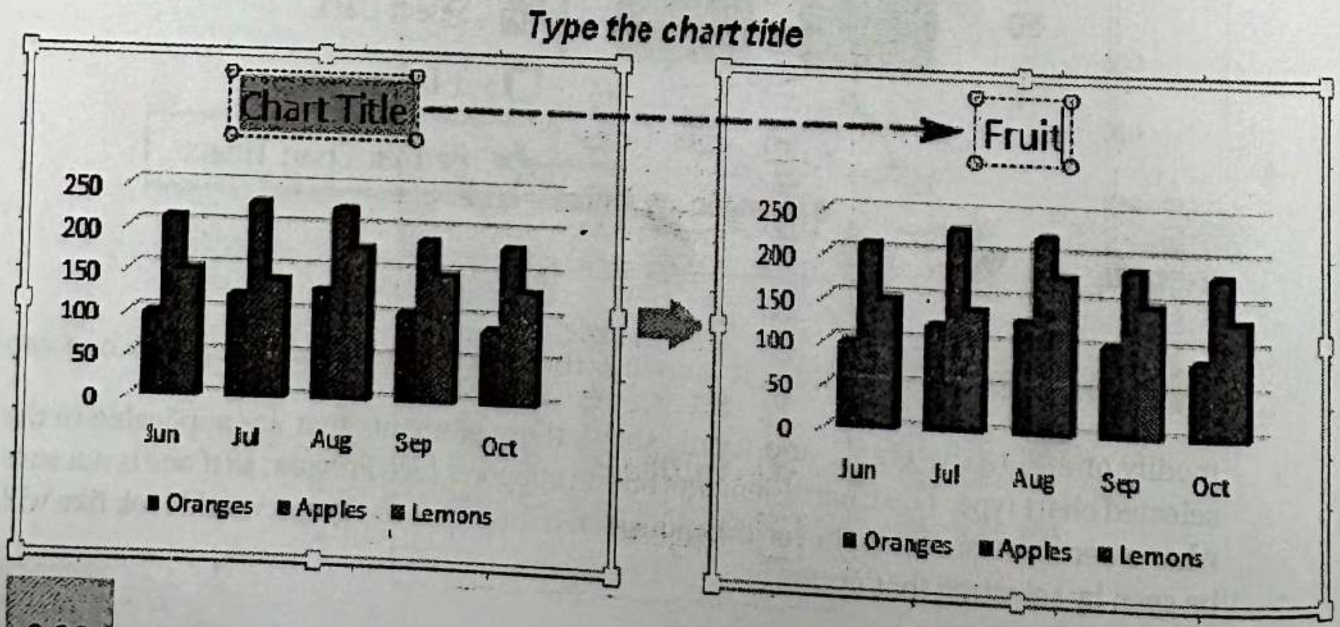
☑ Axes
☑ Axis Titles
☑ Chart Title
☐ Data Labels
☐ Data Table
☑ Gridlines
☑ Legend

☐ Primary Horizontal
☐ Primary Vertical

○ No fill
○ Solid fill
○ Gradient fill
○ Picture or texture fill
○ Pattern fill
● Automatic

8.2.3.1 Add the chart title

A chart is already inserted with the default "*Chart Title*". To change the title text, simply select that box and type the title:


Type the chart title
Chart Title
Fruit
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
Oranges
Apples
Lemons

If for some reason the title was not added automatically, then click anywhere within the graph for the Chart Tools tabs to appear. Switch to the Design tab and click *Add Chart Element > Chart Title > Above Chart I (or Centered Overlay)*

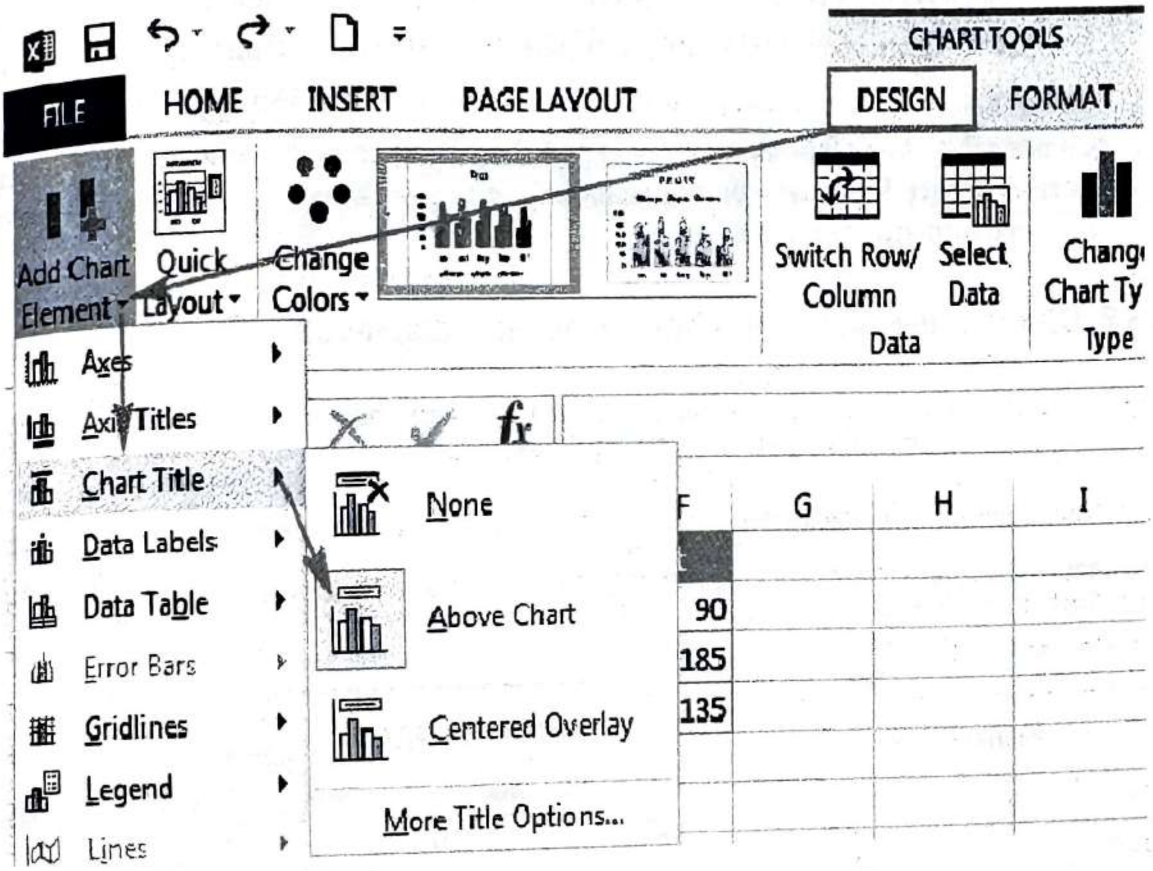


CHART TOOLS
FILE
HOME
INSERT
PAGE LAYOUT
DESIGN
FORMAT
Add Chart Element
Quick Layout
Change Colors
Switch Row/ Column
Select Data
Data
Change Chart Type
Type
Axes
Axis Titles
Chart Title
Data Labels
Data Table
Error Bars
Gridlines
Legend
Lines
None
Above Chart
Centered Overlay
More Title Options...
F
G
H
I
90
185
135

Or, click the *Chart Elements* button in the upper-right corner of the graph, and put a tick in the **Chart Title** checkbox.

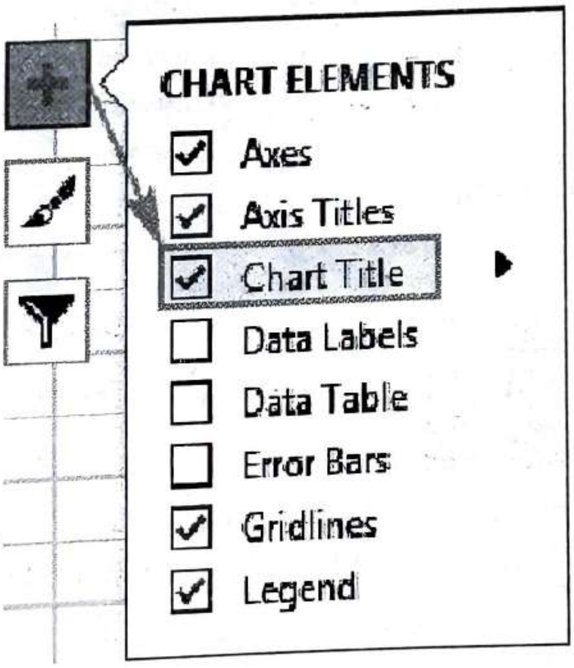


CHART ELEMENTS

☑ Axes
☑ Axis Titles
☑ Chart Title
☐ Data Labels
☐ Data Table
☐ Error Bars
☑ Gridlines
☑ Legend

Additionally, click the arrow next to *Chart Title* and chose one of the following options:

- *Above Chart* - the default option that displays the title at top of the chart area and chang the graph's size.
- *Centered Overlay* - overlays the centered title on the chart without resizing the graph.

For more options, go to the *Design tab* > *Add Chart Element* > *Chart Title* > *More Option*

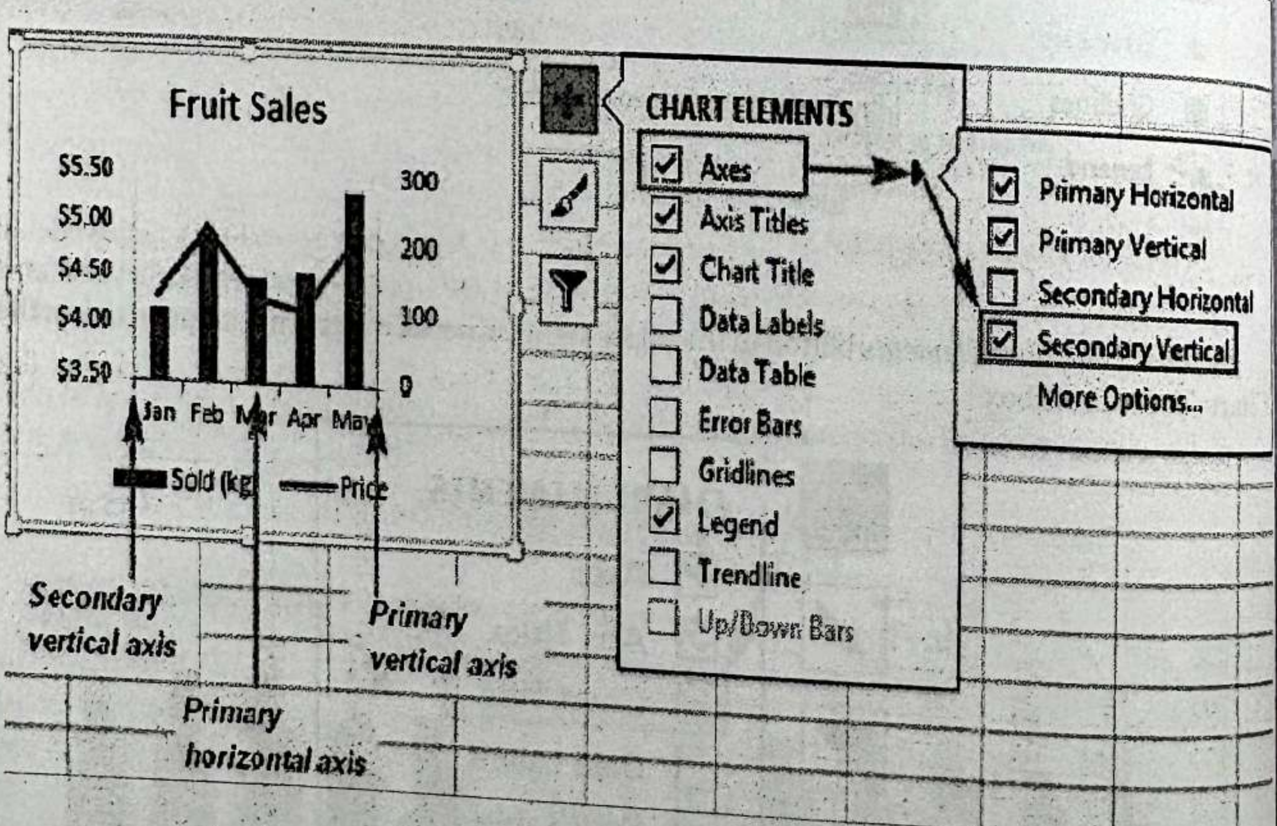
Or, click the Chart Elements button and click *Chart Title* > *More Options...*

Clicking the *More Options* item (either on the ribbon or in the context menu) opens th Format Chart Title pane on the right side of the worksheet, where one can select th required formatting options.

8.2.3.2 Change the way the chart axes are displayed

For most chart types, the vertical axis (*value or Y axis*) and horizontal axis (*category or X axis*) are added automatically when a chart in Excel is prepared.

One can show or hide chart axes by clicking the Chart Elements button ➕ , then clicking th arrow next to Axes, and then checking the boxes for the axes to be shown and unchecking those t be hidden.


Fruit Sales
$5.50
$5.00
$4.50
$4.00
$3.50
300
200
100
0
Jan
Feb
Mar
Apr
May
Sold (kg)
Price
Secondary vertical axis
Primary vertical axis
Primary horizontal axis
CHART ELEMENTS
More Options...

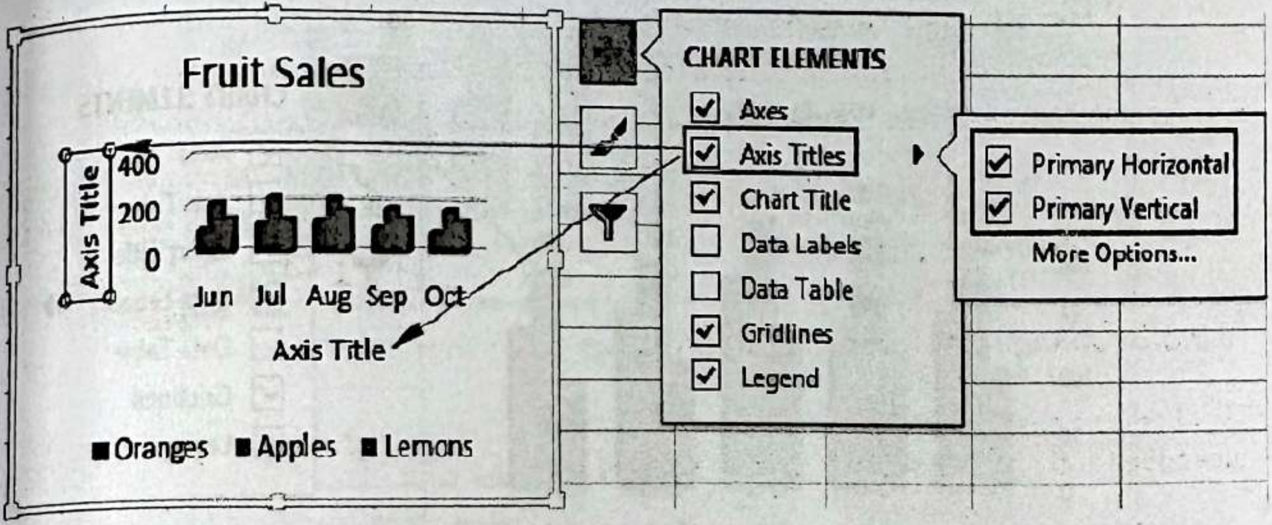
- ☑ Axes
- ☑ Axis Titles
- ☑ Chart Title
- ☐ Data Labels
- ☐ Data Table
- ☐ Error Bars
- ☐ Gridlines
- ☑ Legend
- ☐ Trendline
- ☐ Up/Down Bars

- ☑ Primary Horizontal
- ☑ Primary Vertical
- ☐ Secondary Horizontal
- ☑ Secondary Vertical

✓ Add axis titles to a chart

When creating graphs in Excel, titles can be added to the horizontal and vertical axes to help the users understand what the chart data is about. To add the axis titles, steps are as follows:

1. Click anywhere within the Excel chart, then click the Chart Elements button and check the Axis:


Fruit Sales
Axis Title
400
200
0
Jun
Jul
Aug
Sep
Oct
Axis Title
■ Oranges
■ Apples
■ Lemons
CHART ELEMENTS
☑ Axes
☑ Axis Titles
☑ Chart Title
☐ Data Labels
☐ Data Table
☑ Gridlines
☑ Legend
☑ Primary Horizontal
☑ Primary Vertical
More Options...

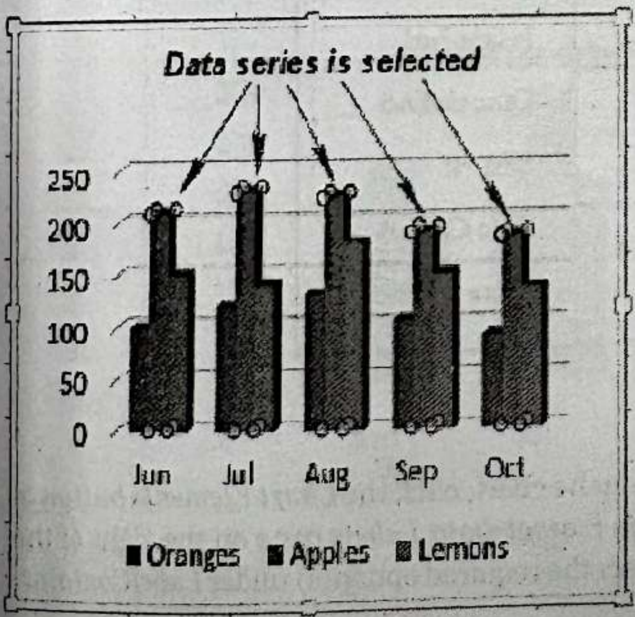
2. Click the axis title box on the chart and type the text.

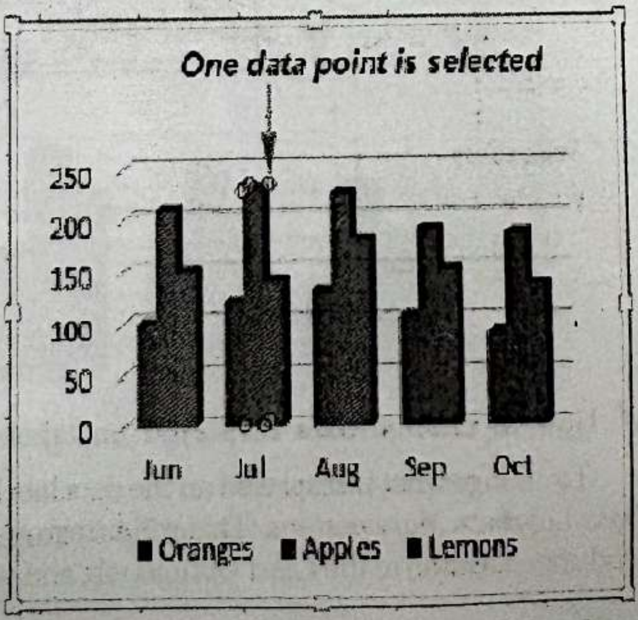
   To format the axis title, right-click it and select *Format Axis* Title from the context menu. The *Format Axis Title* pane will appear with lots of formatting options to choose from.

8.2.3.3 Adding data labels to Excel charts

To make the Excel graph easier to understand, data labels can be added to display details about the data series. Depending on where users' attentionneed to be focussed, \add labels to one data series, all the series, or individual data points.

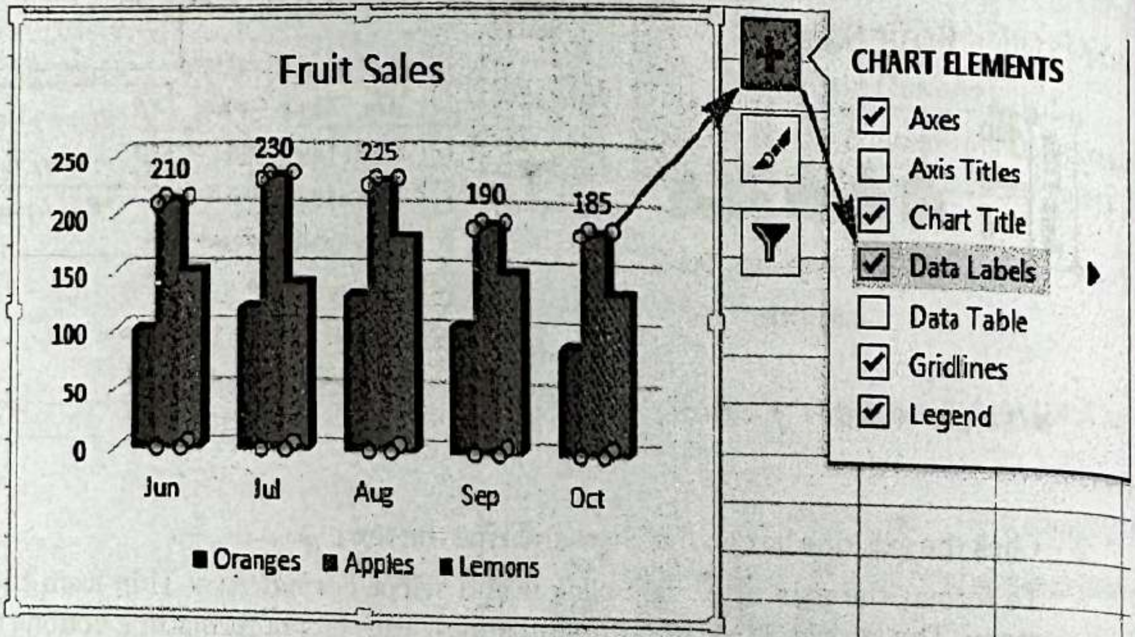
1. Click the data series to be labelled. To add a label to one data point, click that data point after selecting the series.


Data series is selected
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■ Oranges
■ Apples
■ Lemons


One data point is selected
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■ Oranges
■ Apples
■ Lemons

2. Click the Chart Elements button and select the Data Labels option.

   For example, this is how labels can be added to one of the data series in our Excel chart :


Fruit Sales
250
200
150
100
50
0
210
230
225
190
185
Jun
Jul
Aug
Sep
Oct
■ Oranges ■ Apples ■ Lemons
CHART ELEMENTS
☑ Axes
☐ Axis Titles
☑ Chart Title
☑ Data Labels ▸
☐ Data Table
☑ Gridlines
☑ Legend

For specific chart types, such as pie chart, the labels location can also be chosen. For this, click the arrow next to *Data Labels*, and choose the required option. To show data labels inside text bubbles, click *Data Callout*.

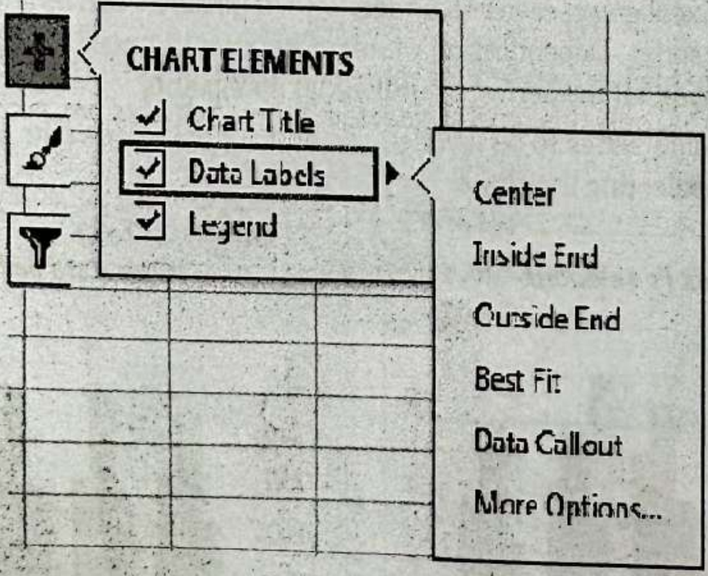
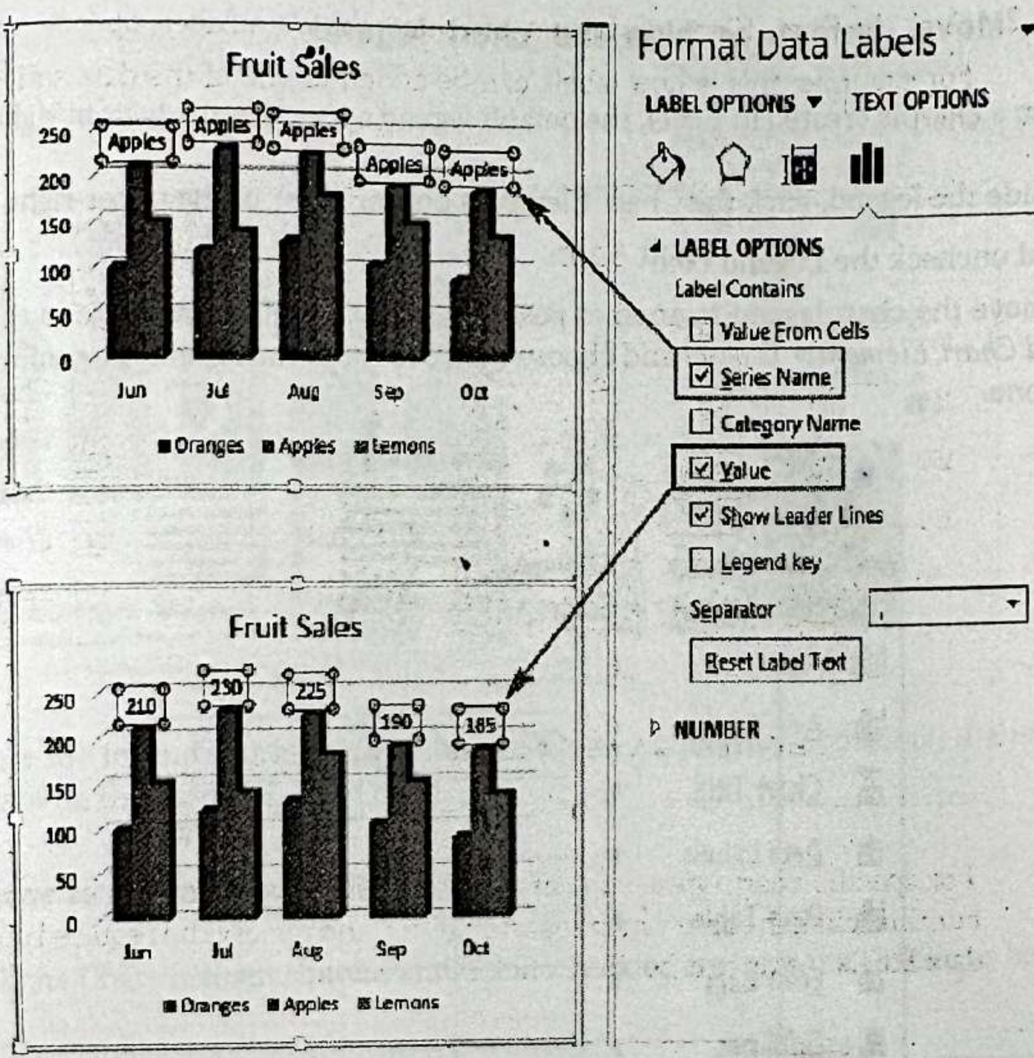


CHART ELEMENTS
☑ Chart Title
☑ Data Labels ▸
☑ Legend
Center
Inside End
Outside End
Best Fit
Data Callout
More Options...

✓ How to change data displayed on labels

To change what is displayed on the data labels in the chart, click the *Chart Elements button > Data Labels > More options*. This will bring up the *Format Data Labels* pane on the right of the worksheet. Switch to the *Label Options* tab, and select the required option(s) under *LabelContains*:


Fruit Sales
Apples
Apples
Apples
Apples
Apples
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■ Oranges ■ Apples ▨ Lemons
Fruit Sales
210
230
225
190
185
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■ Oranges ■ Apples ▨ Lemons

Format Data Labels

LABEL OPTIONS ▾ TEXT OPTIONS

LABEL OPTIONS

Label Contains

☐ Value From Cells

☑ Series Name

☐ Category Name

☑ Value

☑ Show Leader Lines

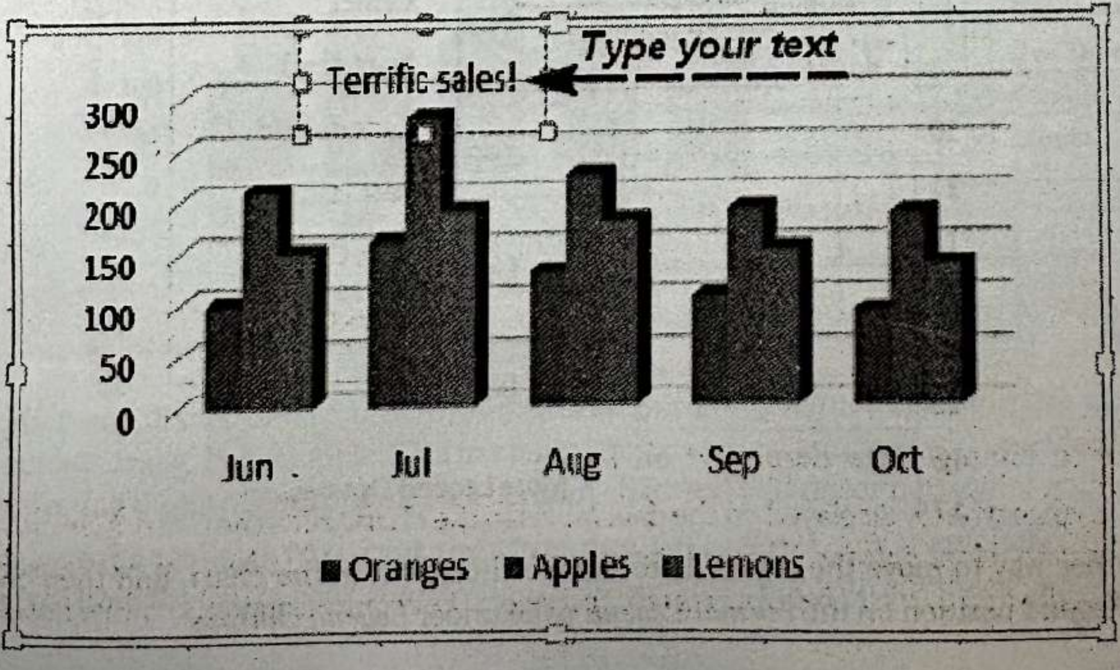
☐ Legend key

Separator

Reset Label Text

NUMBER

If one wants to add his/her own text for some data point, click the label for that data point and then click it again so that only this label is selected. Select the label box with the existing text and type the replacement text:

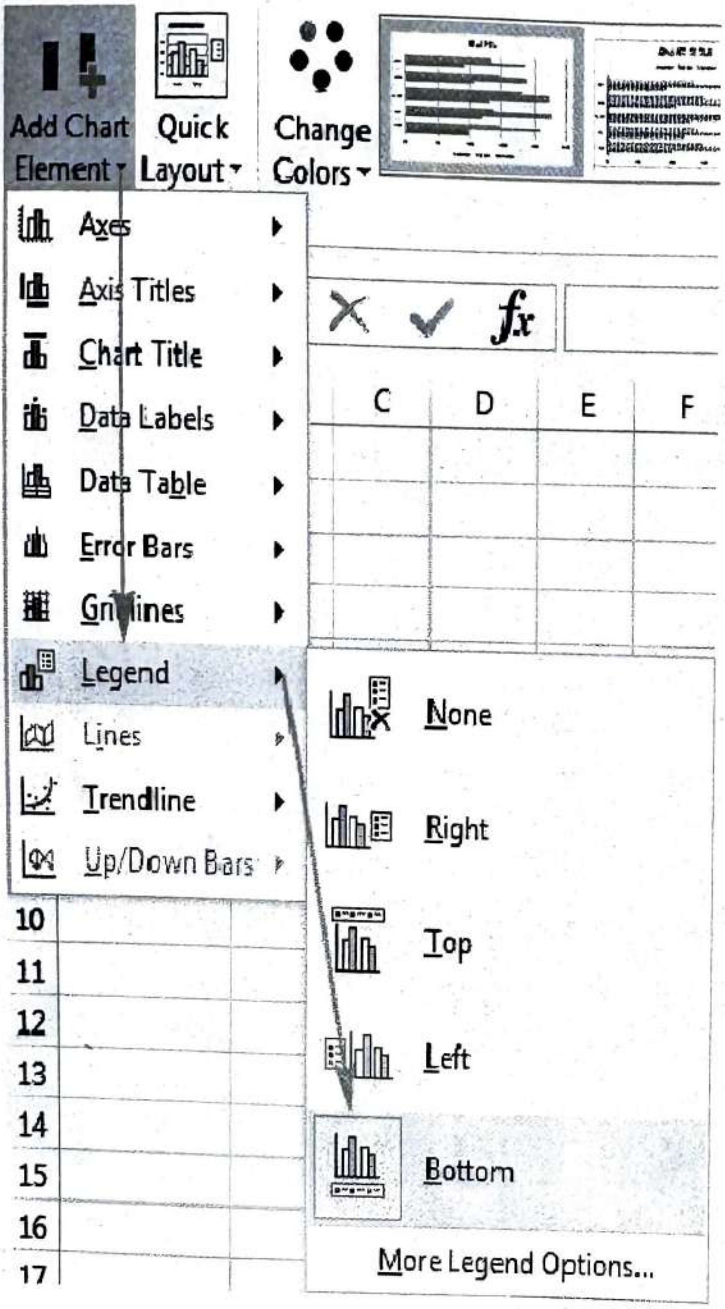

Terrific sales!
Type your text
300
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■ Oranges ■ Apples ■ Lemons

8.2.3.4 Move, format, or hide the chart legend

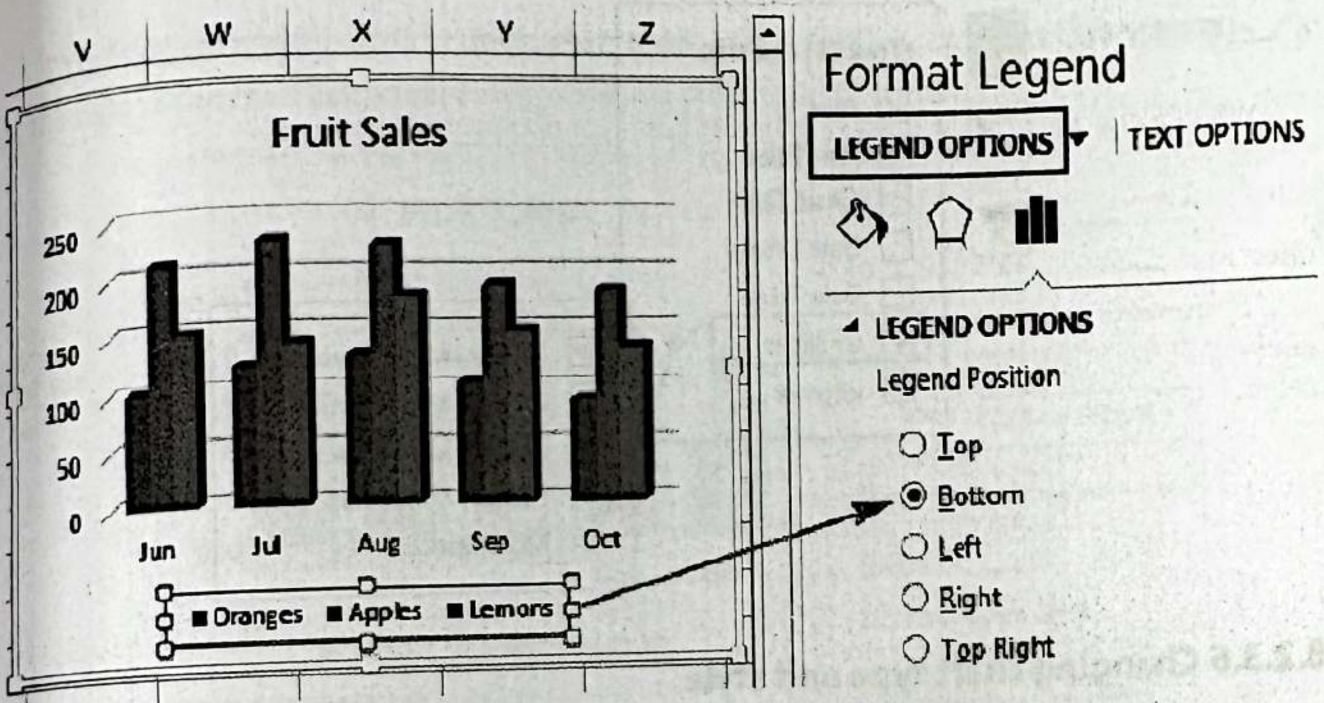
When a chart is created in Excel, the default legend appears at the bottom/right of the chart.

To hide the legend, click the Chart Elements button + in the upper-right corner of the chart and uncheck the Legend box.

To move the chart legend to another position, select the chart, navigate to the Design tab, click *Add Chart Element> Legend* and choose where to move the legend. To remove the legend, select None.


Add Chart Element
Quick Layout
Change Colors
Axes
Axis Titles
Chart Title
Data Labels
Data Table
Error Bars
Gridlines
Legend
Lines
Trendline
Up/Down Bars
C
D
E
F
10
11
12
13
14
15
16
17
None
Right
Top
Left
Bottom
More Legend Options...

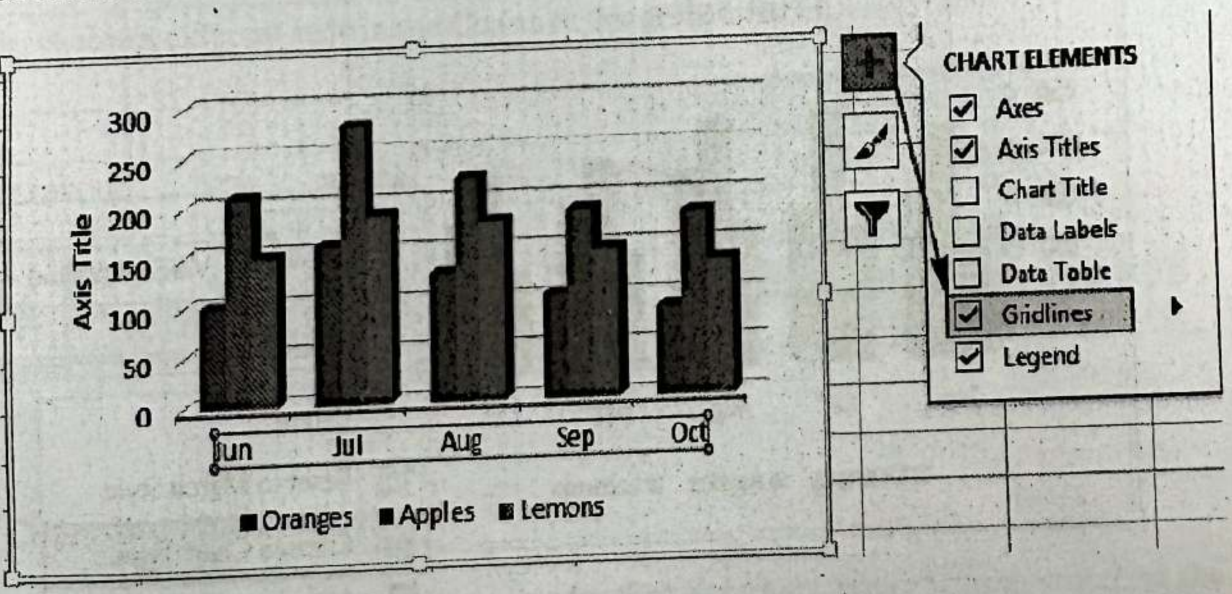
Another way to move the legend is to double-click on it in the chart, and then choose the desired legend position on the *Format Legend* pane under *Legend Options*.


V
W
X
Y
Z
Fruit Sales
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■ Oranges ■ Apples ■ Lemons
Format Legend
LEGEND OPTIONS
TEXT OPTIONS
LEGEND OPTIONS
Legend Position
○ Top
● Bottom
○ Left
○ Right
○ Top Right

To change the legend's formatting, there are plenty of different options on the *Fill & Line* and *Effects* tabs on the *Format Legend* pane.

8.2.3.5 Show or hide the gridlines

- Click the Chart Elementsbutton and either check or uncheck the Gridlines box.


300
250
200
150
100
50
0
Axis Title
Jun
Jul
Aug
Sep
Oct
■ Oranges ■ Apples ■ Lemons
CHART ELEMENTS
☑ Axes
☑ Axis Titles
☐ Chart Title
☐ Data Labels
☐ Data Table
☑ Gridlines
☑ Legend

Microsoft Excel determines the most appropriate gridlines type for the chart type automatically. For example, on a bar chart, major vertical gridlines will be added, whereas selecting the *Gridlines option* on a column chart will add major horizontal gridlines.

To change the gridlines type, click the arrow next to *Gridlines*, and then choose the desired gridlines type from the list, or click *More Options...* to open the pane with advanced *Major Gridlines* options.

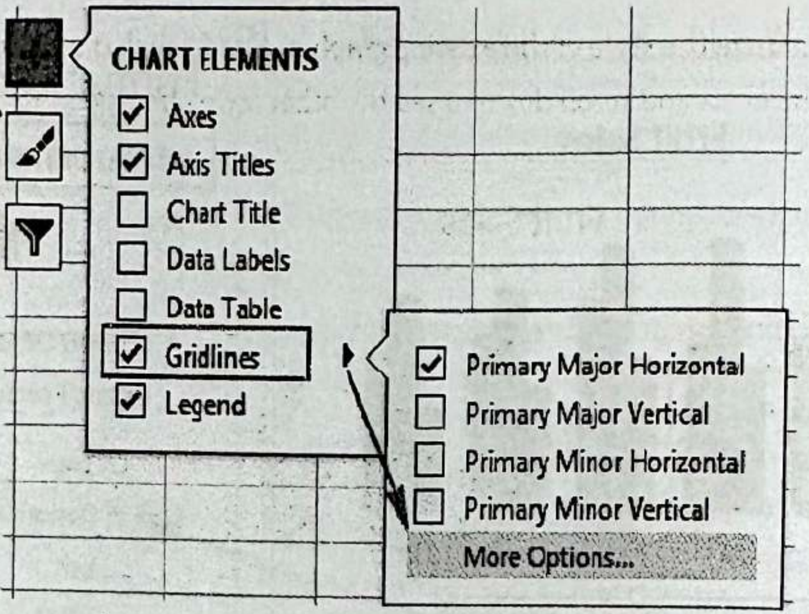
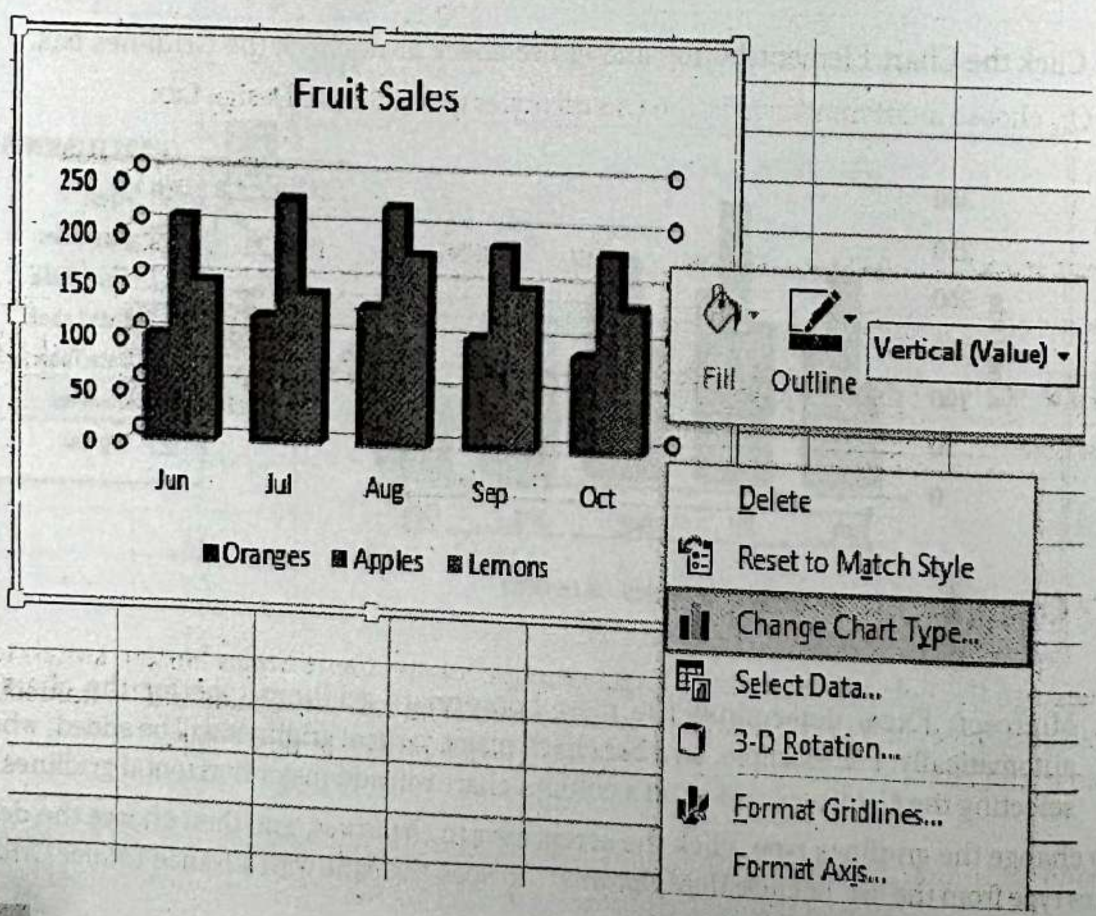


CHART ELEMENTS
☑ Axes
☑ Axis Titles
☐ Chart Title
☐ Data Labels
☐ Data Table
☑ Gridlines
☑ Legend
☑ Primary Major Horizontal
☐ Primary Major Vertical
☐ Primary Minor Horizontal
☐ Primary Minor Vertical
More Options...

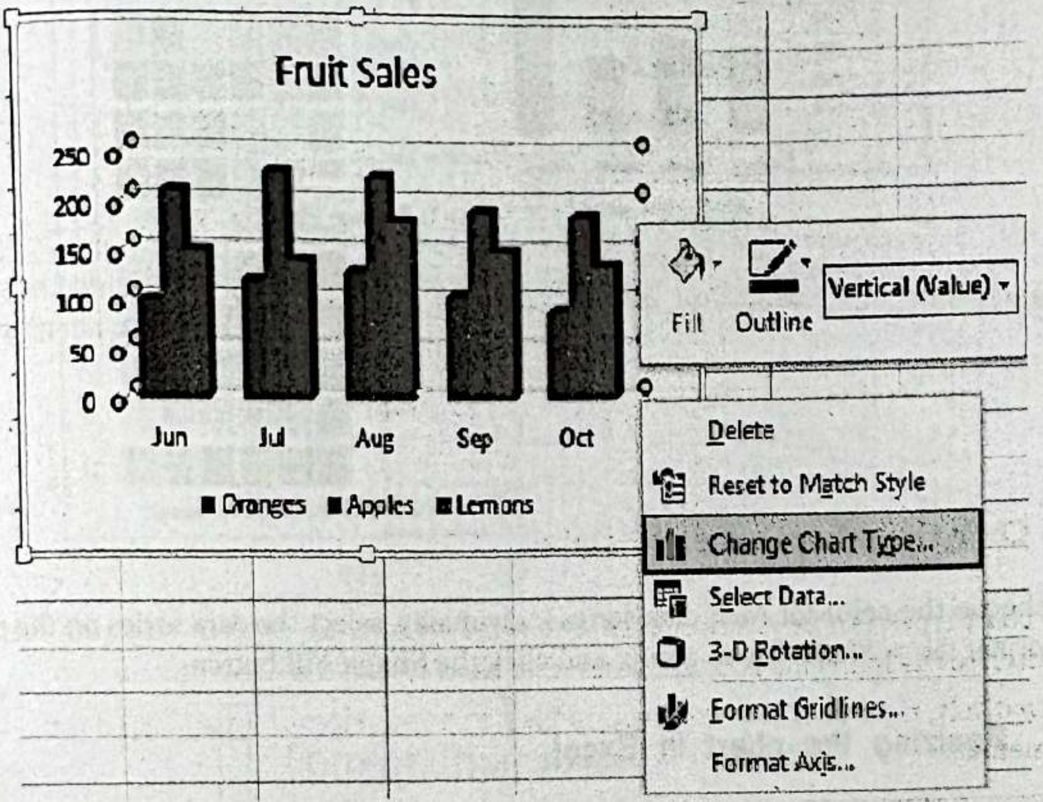
8.2.3.6 Changing chart type and style

One chart types can be easily change it to some other chart type by selecting the existing chart, switch to the Insert tab and choose another chart type in the Charts group.

Alternatively, right-click anywhere within the graph and select Change Chart Type... from the context menu.


Fruit Sales
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■Oranges ■Apples ■Lemons
Fill
Outline
Vertical (Value)
Delete
Reset to Match Style
Change Chart Type...
Select Data...
3-D Rotation...
Format Gridlines...
Format Axis...

To quickly change the style of the existing graph in Excel, click the Chart Styles button on the right of the chart and scroll down to see the other style offerings.


Fruit Sales
250
200
150
100
50
0
Jun
Jul
Aug
Sep
Oct
■ Oranges
■ Apples
■ Lemons
Fill
Outline
Vertical (Value)
Delete
Reset to Match Style
Change Chart Type...
Select Data...
3-D Rotation...
Format Gridlines...
Format Axis...

Or, choose a different style in the Charts Styles group on the Design tab:

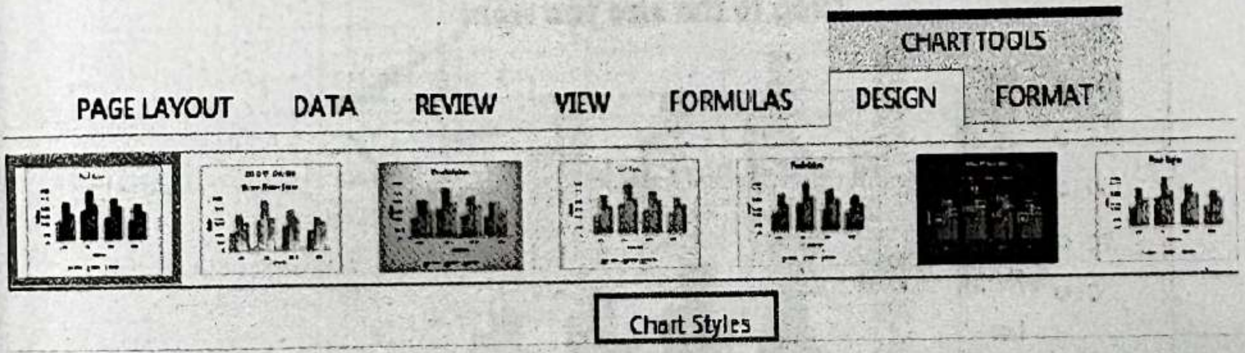
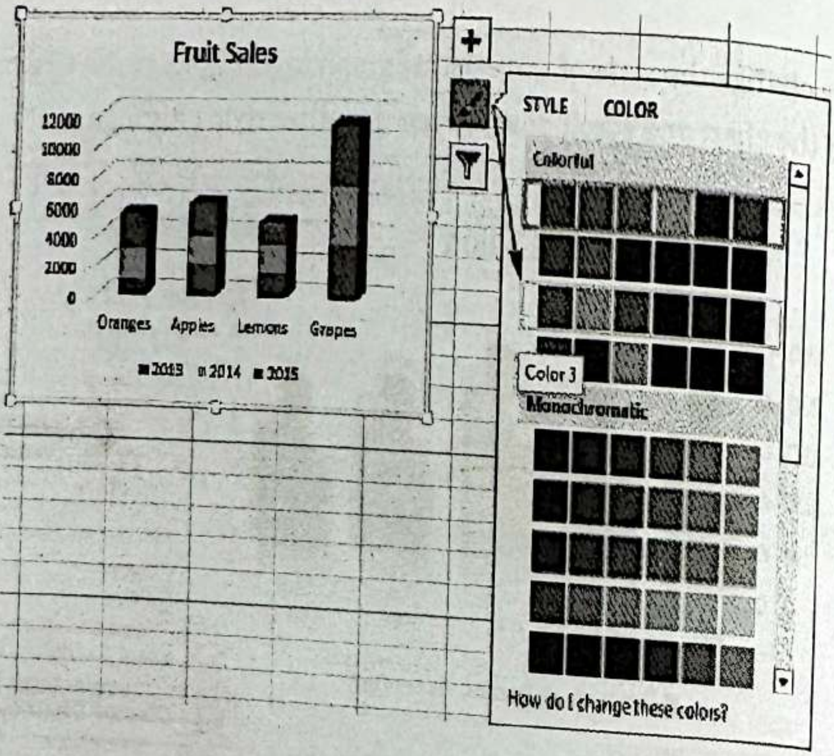


CHART TOOLS
PAGE LAYOUT
DATA
REVIEW
VIEW
FORMULAS
DESIGN
FORMAT
Chart Styles

8.2.3.7 Changing chart colors

To change the color theme of the Excel graph, click the *Chart Styles* button, switch to the Color tab and select one of the available color themes. The selected choice will be immediately reflected in the chart, so one can decide whether it will look well in new colors.


Fruit Sales
12000
10000
8000
6000
4000
2000
0
Oranges
Apples
Lemons
Grapes
2013
2014
2015
STYLE
COLOR
Colorful
Color 3
Monochromatic
How do I change these colors?

To choose the color for each data series individually, select the data series on the chart, go to the Format tab > Shape Styles group, and click the Shape Fill button:

8.2.3.8 Resizing the chart in Excel

To resize the Excel graph, click on it, and then drag the sizing handles to the required size.

Drag to the size you want

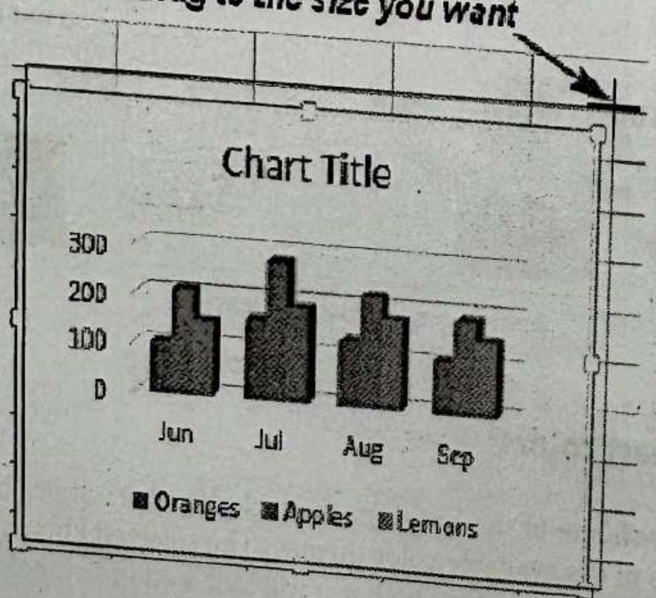


Chart Title
300
200
100
0
Jun
Jul
Aug
Sep
Oranges
Apples
Lemons

Alternatively, enter the desired chart height and width in the Shape Height and Shape Width boxes on the Format tab, in the Size group:

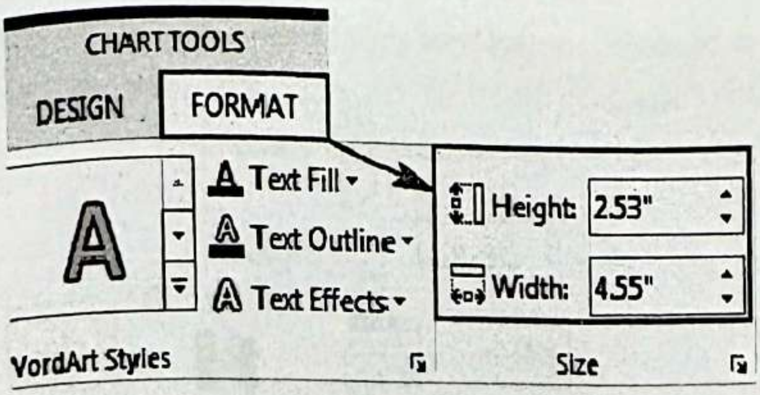
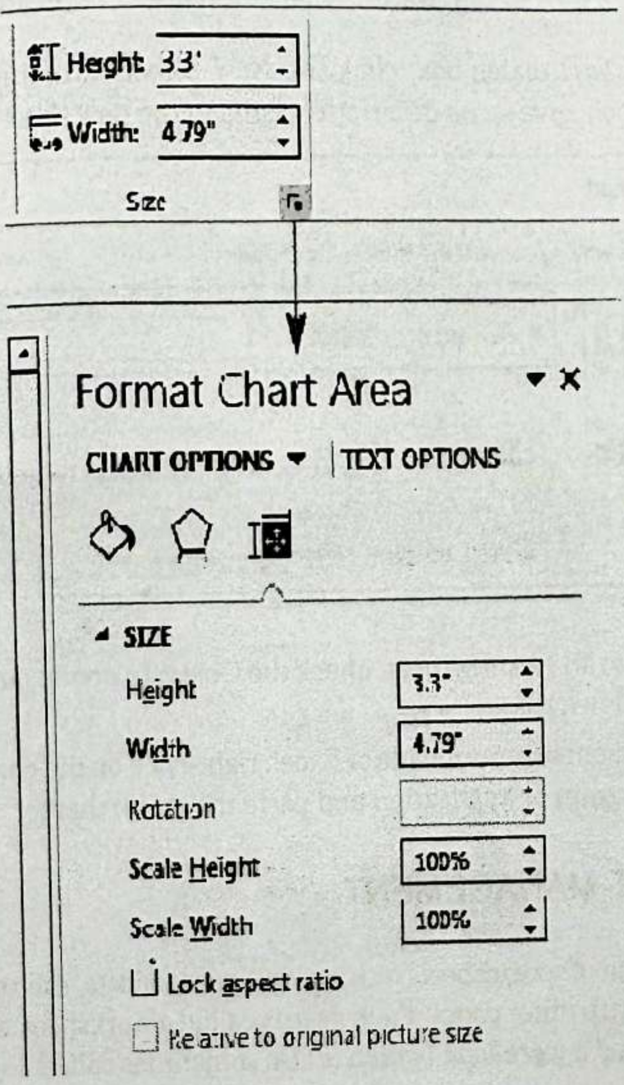


CHART TOOLS
DESIGN
FORMAT
Text Fill
Text Outline
Text Effects
WordArt Styles
Size

Height: 2.53"
Width: 4.55"

For more options, click the Dialog Box Launcher next to Size and configure the needed parameters on the pane.


Size
Format Chart Area
CHART OPTIONS
TEXT OPTIONS
SIZE
Rotation
☐ Lock aspect ratio
☐ Relative to original picture size

Height: 3.3"
Width: 4.79"

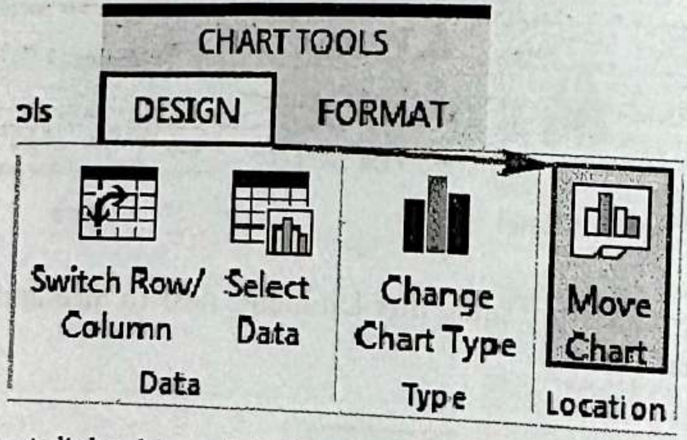
Height 3.3"
Width 4.79"
Scale Height 100%
Scale Width 100%

8.2.4 Moving the chart in Excel

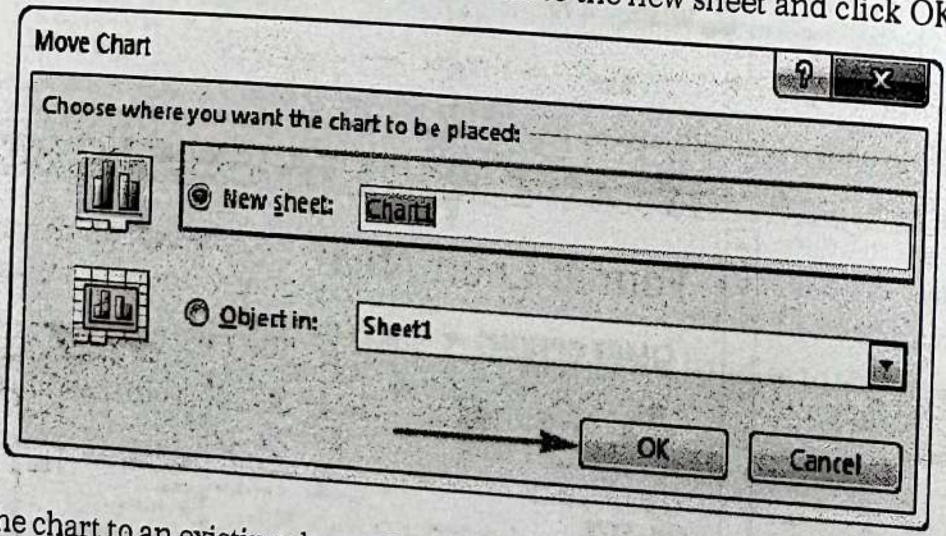
When a graph is created in Excel, it is automatically embedded on the same worksheet as the source data. One can move the chart to any location on the sheet by dragging it with the mouse.

If graph is to be moved on a separate sheet, it can be done in the following way.

1. Select the chart, go to the Design tab on the ribbon and click the Move Chart button.



2. In the *Move Chart* dialog box, click the New Sheet. If multiple chart sheets are to be inserted in the workbook, give some descriptive name to the new sheet and click OK.


Move Chart

Choose where you want the chart to be placed:

● New sheet: Chart1

○ Object in: Sheet1

To move the chart to an existing sheet, check the Object In option, and then select the needed worksheet in the drop-down list.

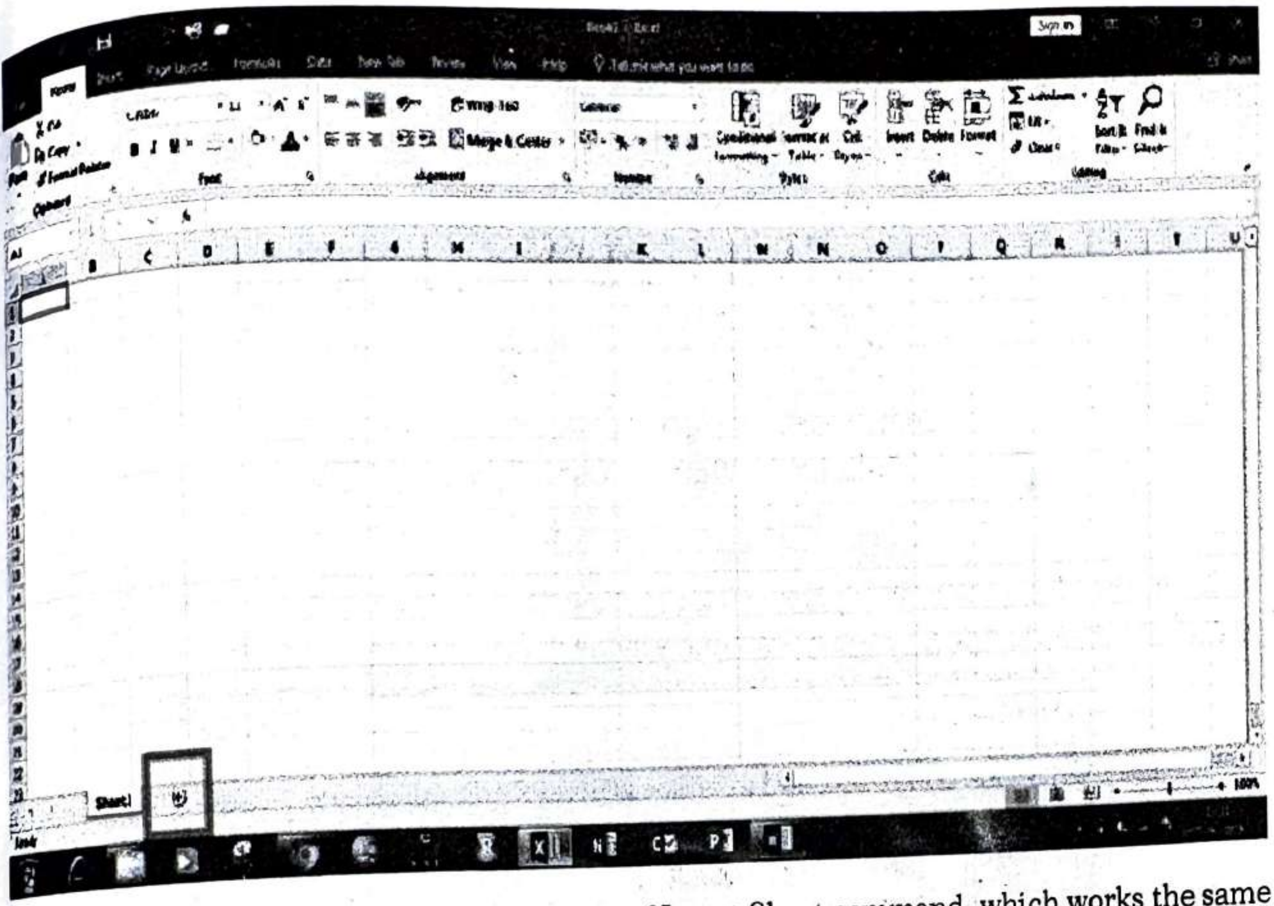
To export the chart somewhere outside of Excel, right-click on the chart border and click Copy. Then open another program or application and paste the graph there.

8.3 WORKSHEET MANAGEMENT

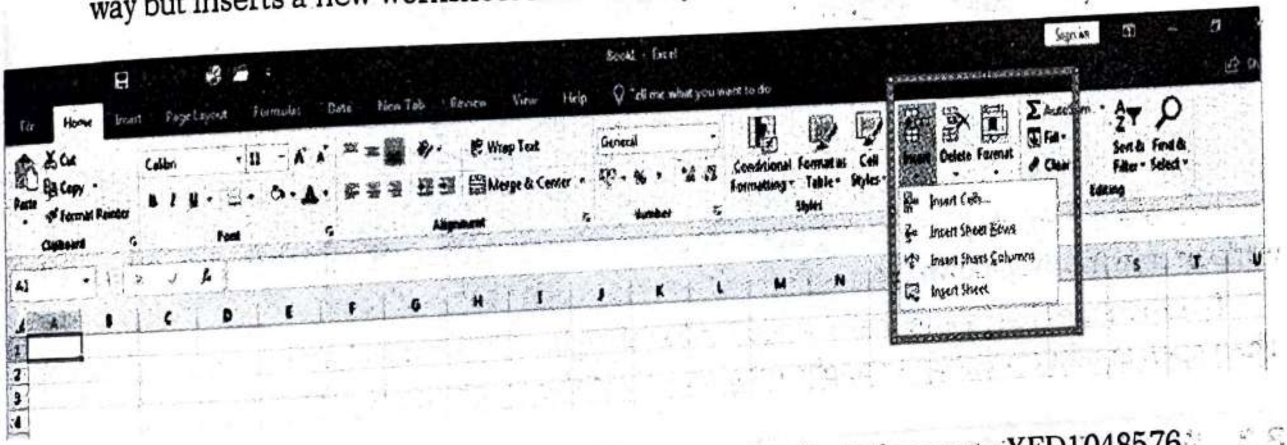
Excel lets the creation of spreadsheets with multiple pages of data, each of which can conveniently exchange information with other pages. Each page is called a worksheet, and a collection of one or more worksheets is called a *workbook* (which is also sometimes called a *spreadsheet file*).

8.3.1 Adding and Removing Worksheets

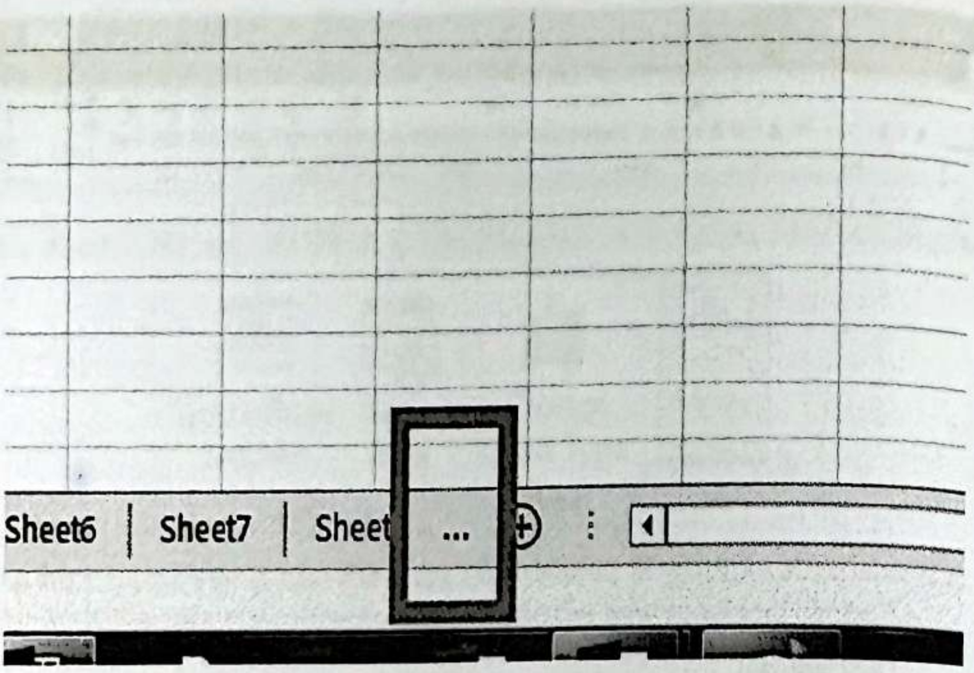
1. When one starts a fresh workbook in Excel, a single blank worksheet is seen. To add more sheets, one need to click the "New sheet" button, which is a small plus-in-a-circle icon that appears immediately to the right of the last worksheet tab.



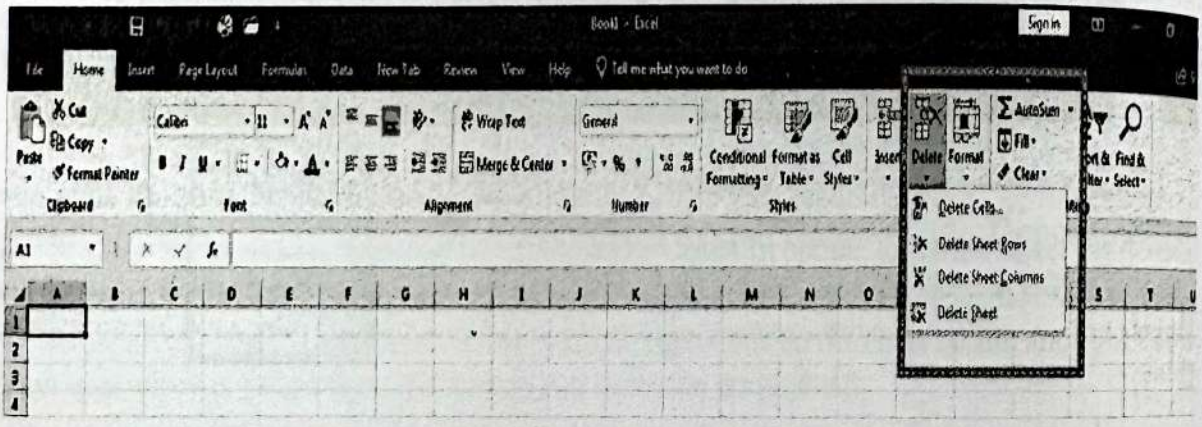
2. One can also use the Home?Cells?Insert?Insert Sheet command, which works the same way but inserts a new worksheet immediately to the left of the current worksheet.


Insert
Delete
Format
Insert Cells...
Insert Sheet Rows
Insert Sheet Columns
Insert Sheet

3. Each worksheet contains a fresh grid of cells—from A1 all the way to XFD1048576.
4. If one continues adding worksheets, it will be found that all the worksheet tabs won't fit at the bottom of the workbook window. Excel uses an ellipsis (...) to indicate the next tab that doesn't fit. For example, if the workbook has worksheets named Sheet1, Sheet2, and Sheet3, and the tab for Sheet3 doesn't quite fit into view at the end of the list, one will see the ellipsis instead.


Sheet6
Sheet7
Sheet
...

5. Removing a worksheet is just as easy as adding one. Simply move to the sheet to get rid of, and then choose *Home→Cells→Delete→Delete Sheet* (alternatively right-click a tab, and then choose Delete). Excel won't complain if oneask it to remove a blank worksheet, but if one try to remove a sheet that contains data, Excel displays a warning message asking for the confirmation.


Book1 - Excel
Sign in
File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell me what you want to do
Paste
Cut
Copy
Format Painter
Clipboard
Calibri
11
Font
Wrap Text
Merge & Center
Alignment
General
Number
Conditional Formatting
Format as Table
Cell Styles
Styles
Insert
Delete
Format
AutoSum
Fill
Clear
Sort & Filter
Find & Select
Delete Cells...
Delete Sheet Rows
Delete Sheet Columns
Delete Sheet
A1

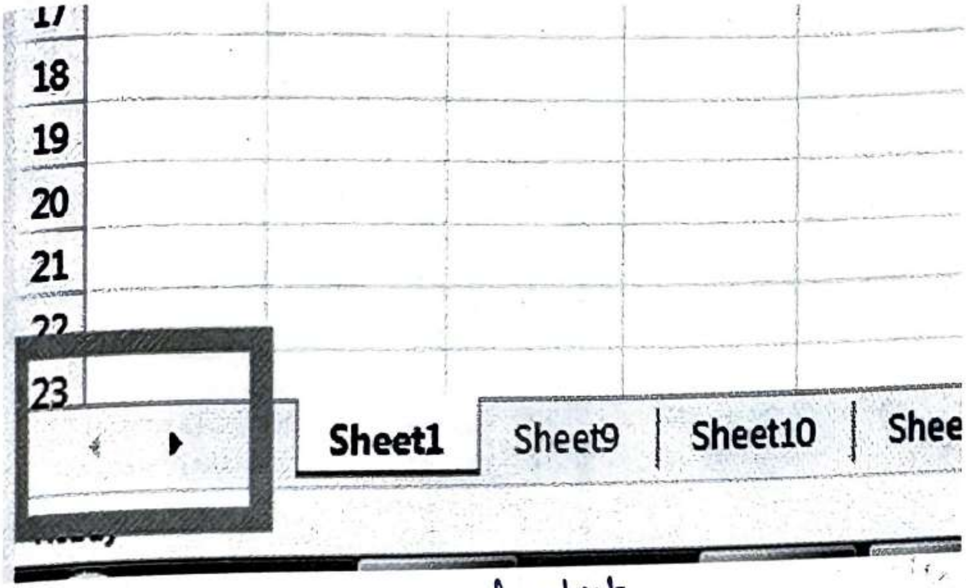
> If there is one last worksheet, Excel won't remove it. Doing so would create a tough existential dilemma for Excel—a workbook that holds no worksheets—so the program prevents from taking this step.
>
> Be careful before deleting a worksheet, because it can't be reversed by using Undo (Ctrl+Z)!

8.3.2 Moving Between Worksheets

To move from one worksheet to another, one have a few choices:

Choice 1 : Click the worksheet tabs at the bottom of Excel's grid window (just above the status bar).

Choice 2 : If onehave way more worksheets than fit into the tab list, one will need to use the scroll buttons, which are immediately to the left of the worksheet tabs) to review the list of worksheets.



Choice 3 : Keyboard Shortcut

bottom of sheet

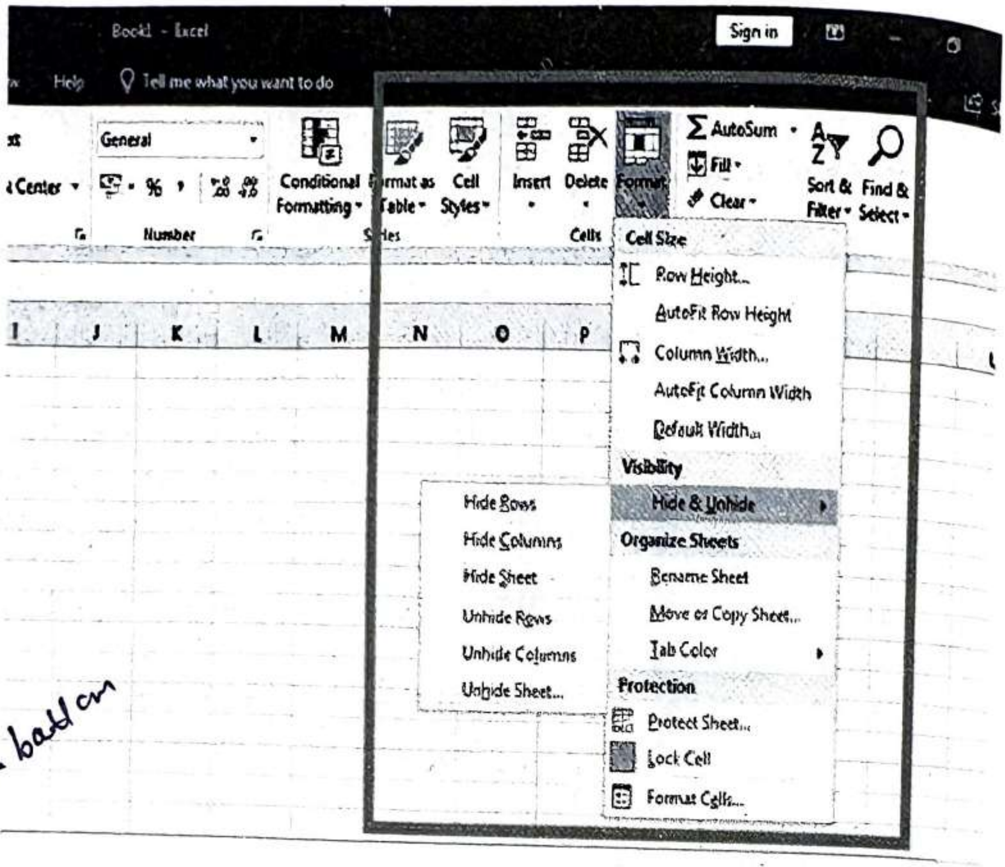
- Press Ctrl+Page Down to move to the next worksheet. For example, if one is currently in Sheet1, this key sequence jumps him/her to Sheet2 (assuming the sheets are in order).
- Press Ctrl+Page Up to move to the previous worksheet. For example, if one is currently in Sheet2, this key sequence takes him/her to Sheet1.

top of sheets.

8.3.3 Hiding Worksheets

Deleting worksheets isn't the only way to tidy up a workbook or get rid of information one doesn't want. A worksheet can also be hidden temporarily.

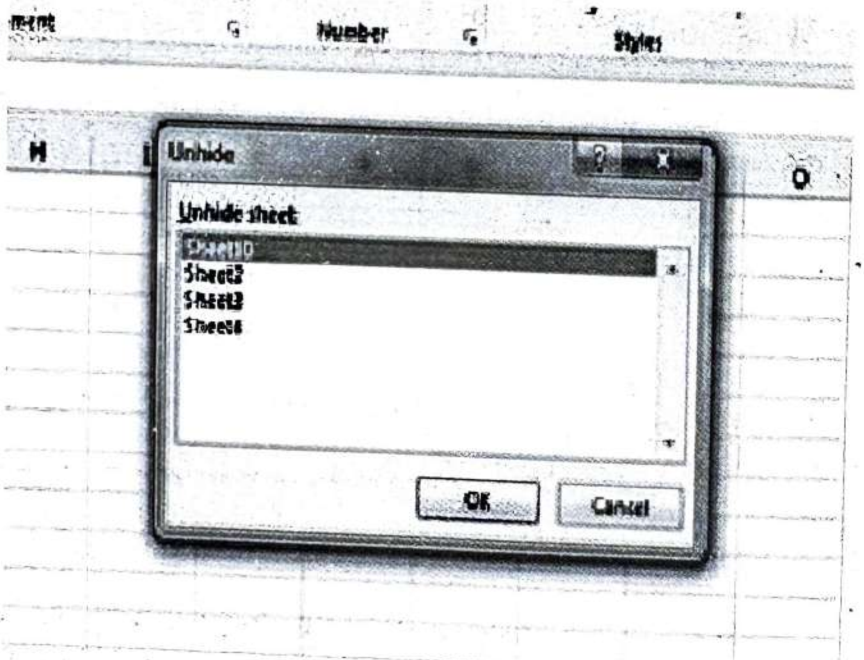
When onehides a worksheet, its tab disappears, but the worksheet itself remains part of the workbook file, and is available whenever one choose to unhide it. One can't print a hidden worksheet, either.


Book1 - Excel
Sign in
Help
Tell me what you want to do
General
Center
Number
Conditional Formatting
Format as Table
Cell Styles
Styles
Insert
Delete
Format
Cells
AutoSum
Fill
Clear
Sort & Filter
Find & Select
Cell Size
Row Height...
AutoFit Row Height
Column Width...
AutoFit Column Width
Default Width...
Visibility
Hide & Unhide
Organize Sheets
Rename Sheet
Move or Copy Sheet...
Tab Color
Protection
Protect Sheet...
Lock Cell
Format Cells...
Hide Rows
Hide Columns
Hide Sheet
Unhide Rows
Unhide Columns
Unhide Sheet...
I
J
K
L
M
N
O
P

Unhide by Short cut from sheet button

To hide a worksheet, right-click the worksheet tab, and then choose Hide. (Or, for a more long-winded approach, choose Home→Cells→Format→Hide&Unhide→Hide Sheet)

same process to unhide.


Number
Styles
H
O
Unhide
Unhide sheet:
Sheet10
Sheet2
Sheet3
Sheet5
OK
Cancel

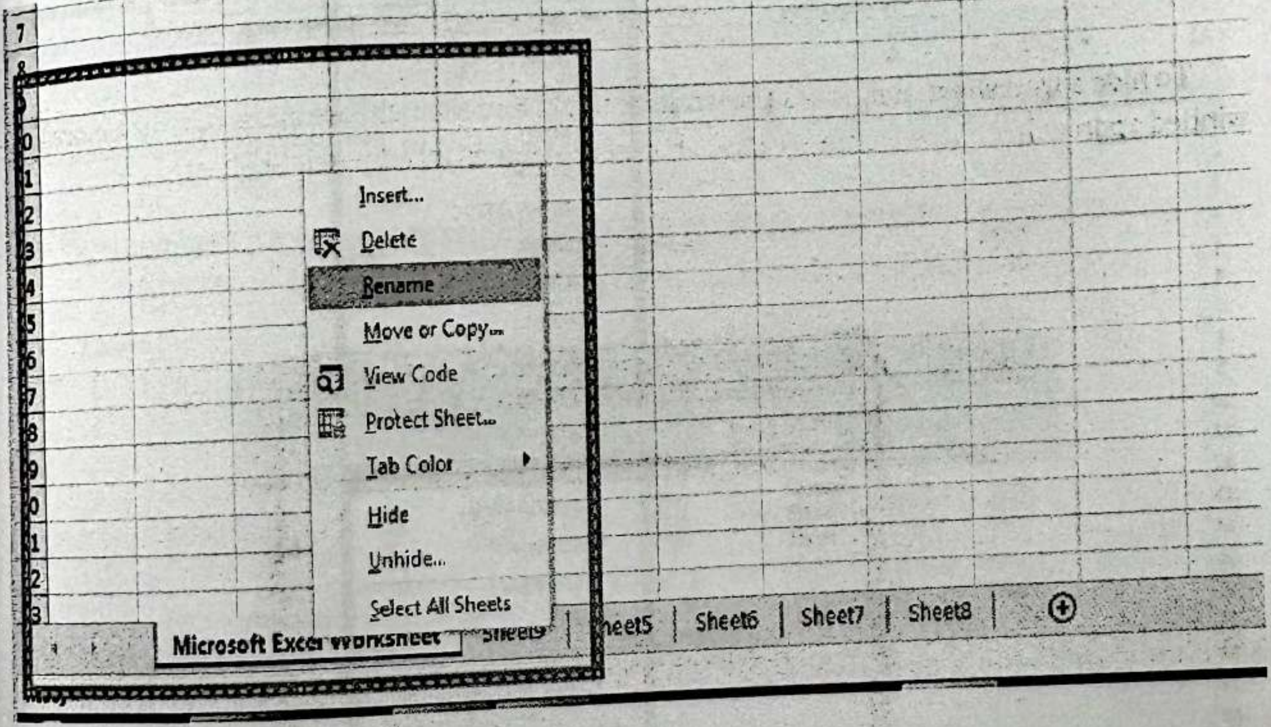
To redisplay a hidden worksheet, right-click any worksheet tab, and then choose Unhide. The Unhide window appears along with a list of all hidden sheets.

Select a sheet from the list, and then click OK to unhide it. (Once again, the ribbon the same window—just click Home?Cells?Format?Hide&Unhide?Unhide Sheet.)

8.3.4 Naming Worksheets

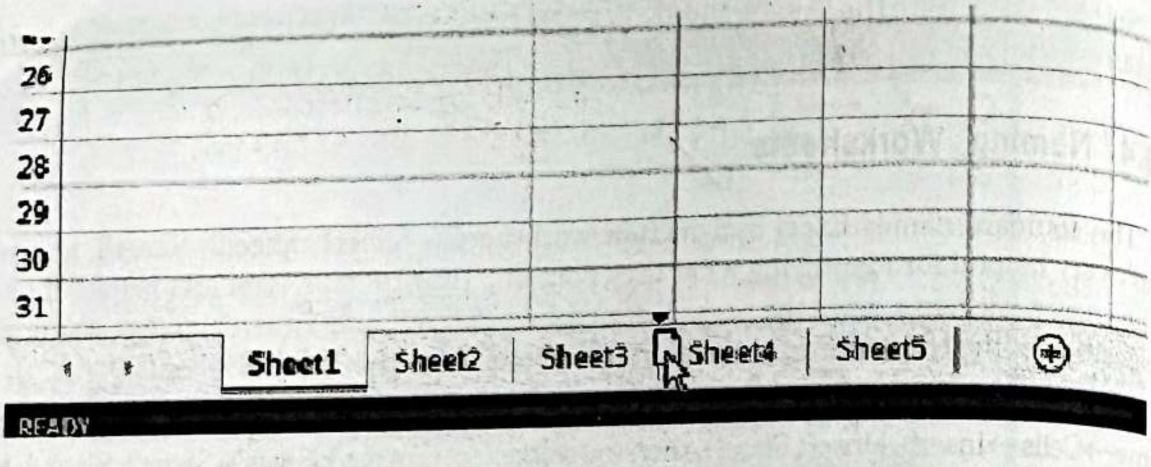
The standard names Excel assigns new worksheets—Sheet1, Sheet2, Sheet3, and so on—aren't very helpful for identifying what they contain. They become even less helpful if one start adding new worksheets, since the new sheet numbers (Sheet2, and so on) don't necessarily indicate the position of the sheets, just the order in which one created them.

For example, if one is on Sheet 3 and one add a new worksheet (by choosing Home→Cells→Insert→Insert Sheet), then the worksheet tabs read: Sheet1, Sheet2, Sheet4, Sheet3. (That's because the Insert Sheet command inserts the new sheet just before the current sheet.) Excel doesn't expect one to stick with these auto-generated names. Worksheets can be renamed by right-clicking the worksheet tab and selecting Rename, or by just double-clicking the sheet name. Either way, Excel highlights the worksheet tab, and a new name can be typed directly in the tab. The worksheet names can have up to 31 characters and include letters, numbers, some symbols, and spaces.



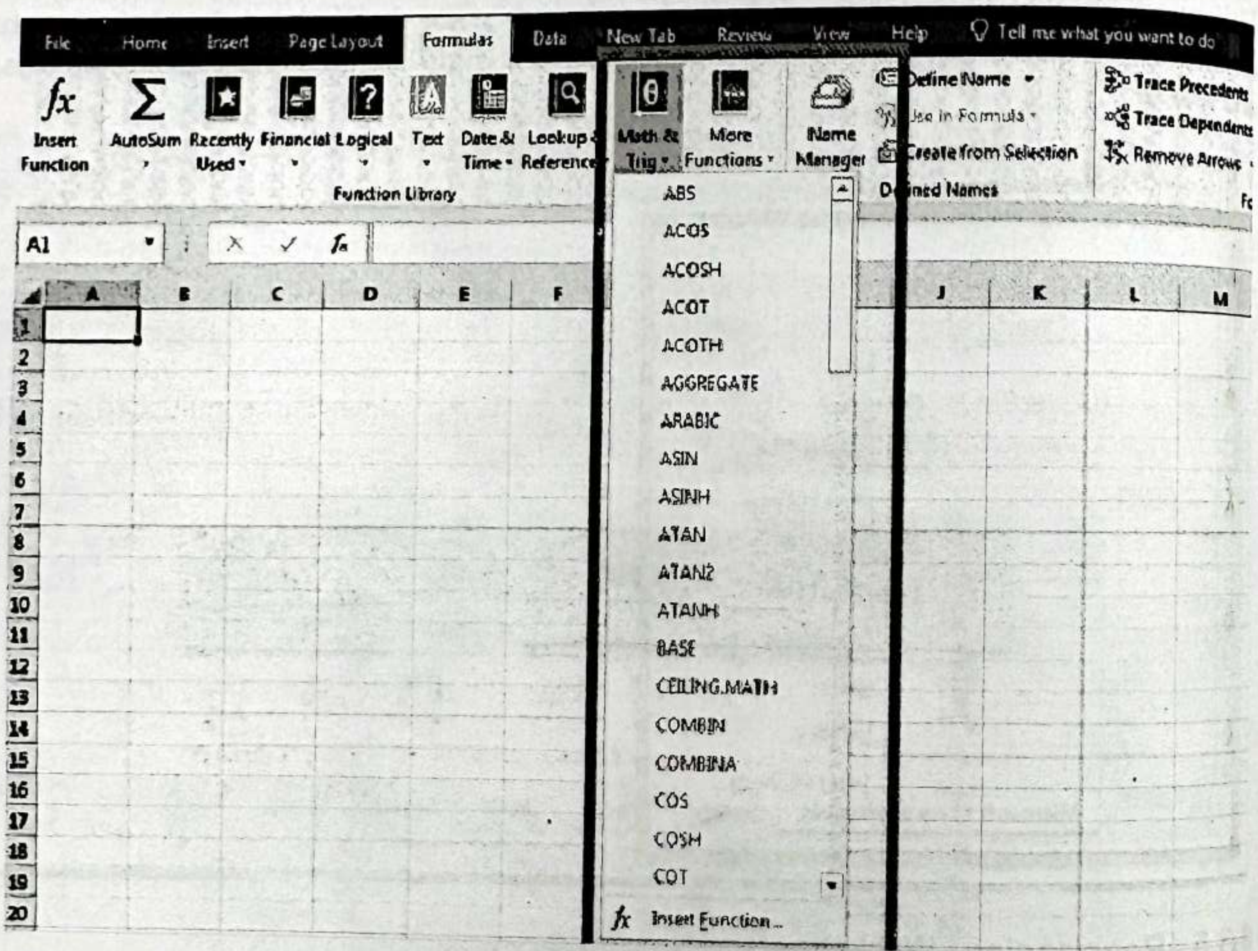
8.3.5 Rearranging Worksheets

One can easily rearrange any of their sheets just by dragging their tabs from one place to another. When a worksheet tab is dragged, a tiny page appears beneath the arrow cursor. As the cursor is moved around, a black triangle appear, indicating where the worksheet will land when the mouse button will be released.


26
27
28
29
30
31
Sheet1
Sheet2
Sheet3
Sheet4
Sheet5
READY

8.4 MATHEMATICAL FUNCTIONS

There are numerous mathematical and Trigonometric functions in Excel.


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell me what you want to do
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
More Functions
Name Manager
Define Name
Use in Formula
Create from Selection
Defined Names
Trace Precedents
Trace Dependents
Remove Arrows
Function Library
A1
ABS
ACOS
ACOSH
ACOT
ACOTH
AGGREGATE
ARABIC
ASIN
ASINH
ATAN
ATAN2
ATANH
BASE
CEILING.MATH
COMBIN
COMBINA
COS
COSH
COT
Insert Function...

The most commonly used Mathematical Functions are as follows:

8.4.1 PRODUCT function

The PRODUCT function multiplies all the numbers given as arguments and returns the product. For example, if cells A1 and A2 contain numbers, the formula =PRODUCT(A1, A2) can be used to

multiply those two numbers together. The same operation can be performed by using the
(*) mathematical operator; for example, =A1 * A2.

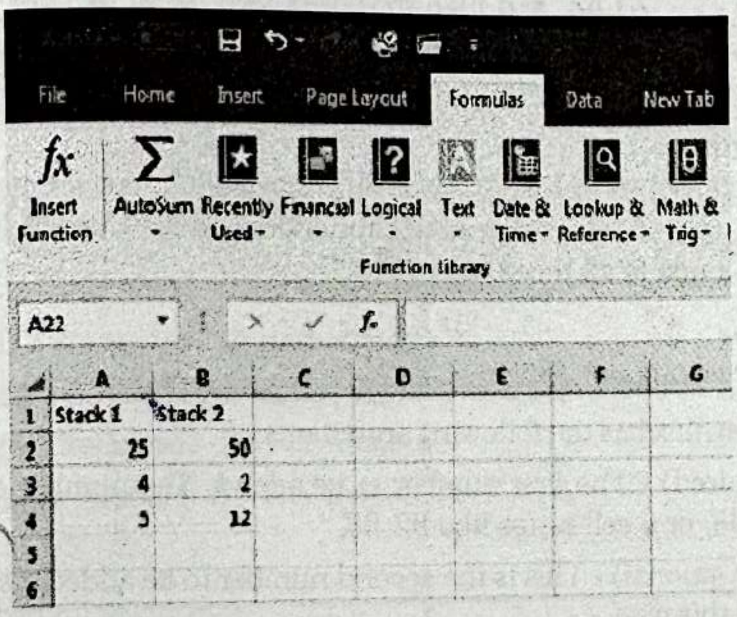
The PRODUCT function is useful when many cells together need to be multilied. For exa
the formula =PRODUCT(A1:A3, C1:C3) is equivalent to =A1 * A2 * A3 * C1 * C2 * C3.

✓ **Syntax**

PRODUCT(number1, [number2], ...)

The PRODUCT function syntax has the following arguments:

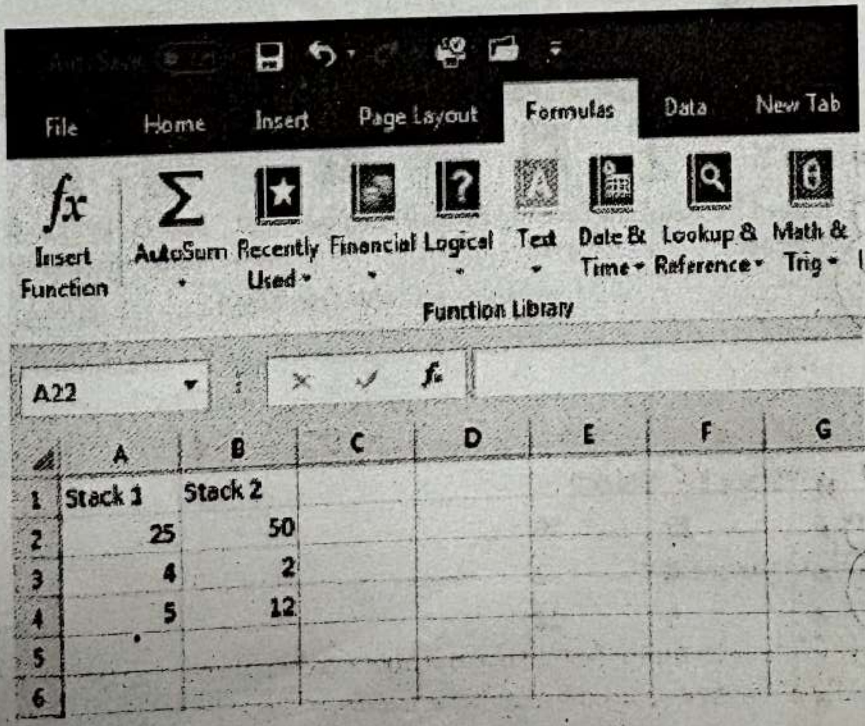
- number1 (Required) - The first range that need to be multiplied.


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
Function library
A22

	A	B	C	D	E	F	G
1	Stack 1	Stack 2					
2	25	50					
3	4	2					
4	5	12					
5							
6							

- number2 (Optional) - Additional numbers or ranges that need to be multiplied, up to a maximum of 255 arguments.

✓ Example:


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
Function Library
A22

	A	B	C	D	E	F	G
1	Stack 1	Stack 2					
2	25	50					
3	4	2					
4	5	12					
5							
6							

Formula	Description	Result
=PRODUCT(A2:A4)	Multiplies the numbers in cells A2 through A4.	500
=PRODUCT(A2:A4, 3)	Multiplies the numbers in cells A2 through A4, and then multiplies that result by 3.	1500
=PRODUCT(A2:A4, B2:B4)	Multiplies the numbers in cells A2 through A4, and then multiplies that result by cells B2 through B4	600000

8.4.2 SUM Function

The SUM function, one of the math and trig functions, adds values of Individual cells, cell references or ranges or a mix of all three.

✓ Syntax

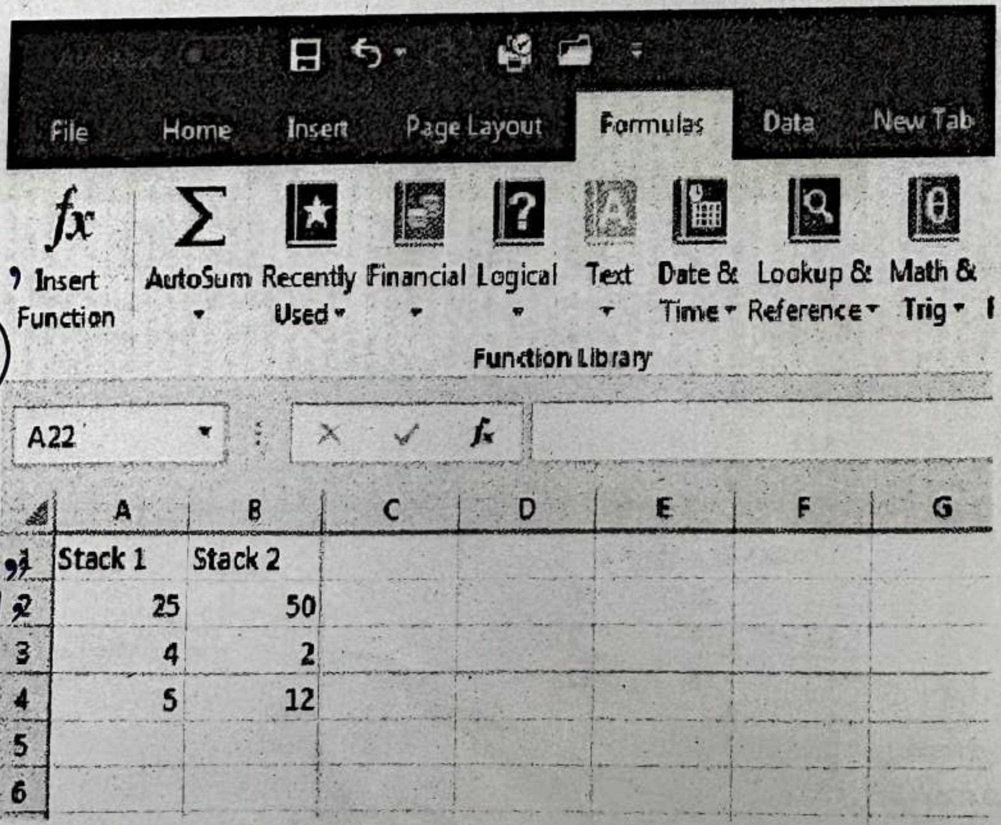
SUM (number1,[number2],...)

The SUM function syntax has the following arguments:

- number1 (Required) - The first number to be added. The number can be like 4, a cell reference like B6, or a cell range like B2:B8.
- number2-255 (Optional) - This is the second number to be added. One can specify up to 255 numbers in this way.

✓ Example :

SumiF
select
(Range, "Grocery", Range.sales)


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
Function Library
A22
fx

	A	B	C	D	E	F	G
1	Stack 1	Stack 2					
2	25	50					
3	4	2					
4	5	12					
5							
6							

umiFs
(sale range, "Grocery" range, state range, "bihar")

Formula	Description	Result
=SUM(A2:A4)	Adds the numbers in cells A2 through A4.	34
=SUM(A2:A4, 3)	Adds the numbers in cells A2 through A4, and then Add 3 to that result	37
=SUM(A2:A4, B2:B4)	Add the numbers in cells A2 through A4, and then Add the result to the sum of the cells B2 through B4	98

8.4.3 QUOTIENT function

Returns the integer portion of a division. Use this function when the remainder of a division is to be discarded.

✓ Syntax

QUOTIENT(numerator, denominator)

The QUOTIENT function syntax has the following arguments:

- Numerator (Required) - The dividend.
- Denominator (Required) - The divisor.

✓ Example

Formula	Description	Result
=QUOTIENT (A2,A4)	A2 is the numerator and A 4 is the denominator	5

8.4.4 SQRT Function

Returns a positive square root.

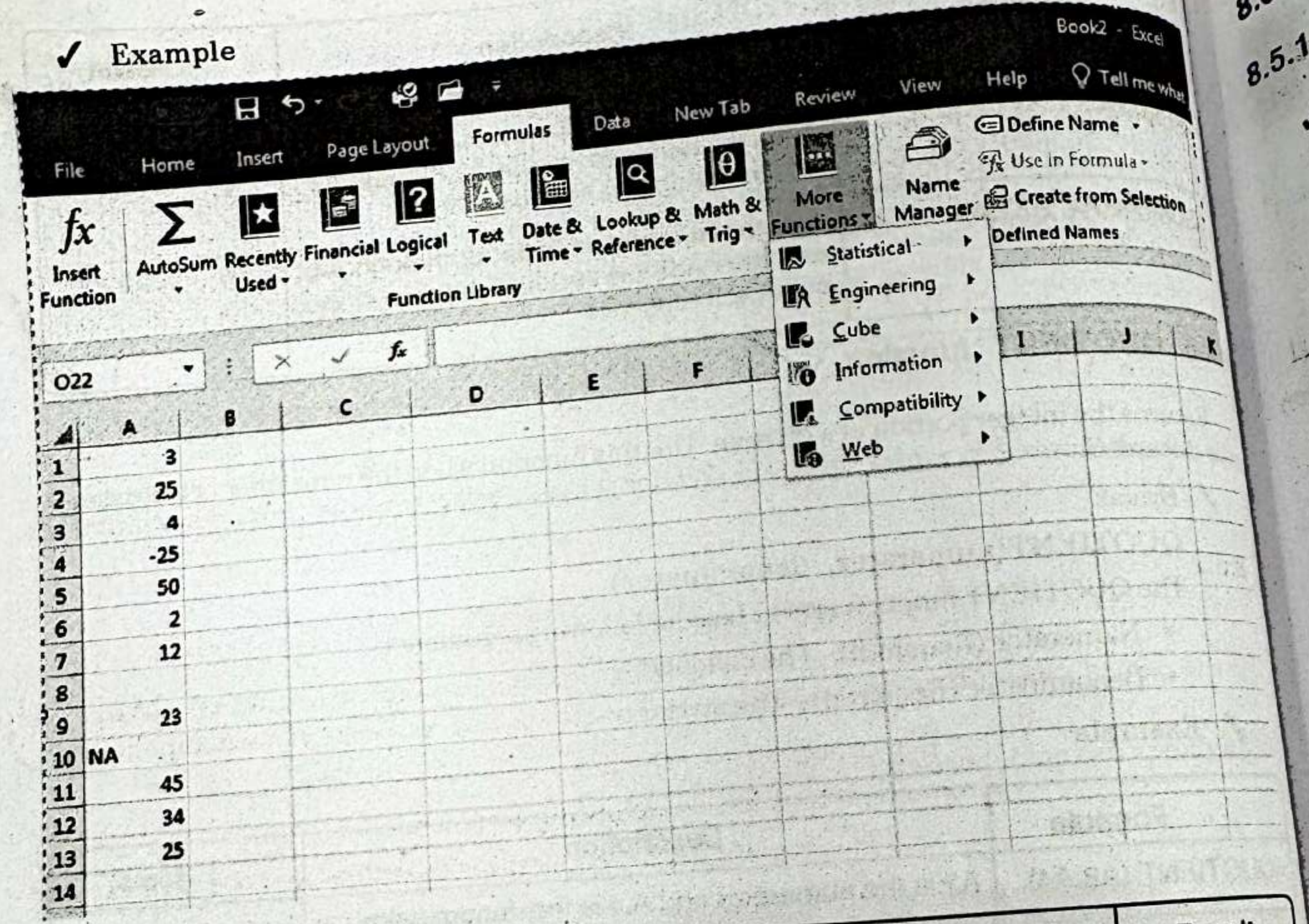
✓ Syntax

SQRT(number)

The SQRT function syntax has the following arguments:

- Number (Required) - The number for which the square root is need to be done.

✓ Example


Book2 - Excel
File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell me what
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
More Functions
Statistical
Engineering
Cube
Information
Compatibility
Web
Function Library
Name Manager
Define Name
Use in Formula
Create from Selection
Defined Names
O22
fx
A
B
C
D
E
F
I
J
K

	A
1	3
2	25
3	4
4	-25
5	50
6	2
7	12
8	
9	23
10	NA
11	45
12	34
13	25
14	

Formula	Description	Result
=SQRT(A2)	Square root of 25	5
= SQRT(A4)	Square root of -25. Because the number is negative, the #NUM! error message is returned.	#NUM!
=SQRT(ABS(A4))	Avoiding the #NUM! error message by first using the ABS function to find the absolute value of -16 and then finding the square root.	5

Formula	Description	Result
=SUM(A2:A4)	Adds the numbers in cells A2 through A4.	34
=SUM(A2:A4, 3)	Adds the numbers in cells A2 through A4, and then Add 3 to that result	37
=SUM(A2:A4, B2:B4)	Add the numbers in cells A2 through A4, and then Add the result to the sum of the cells B2 through B4	98

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- Denominator (Required) - The divisor.

✓ Example

Formula	Description	Result
=QUOTIENT (A2,A4)	A2 is the numerator and A 4 is the denominator	5

8.4.4 SQRT Function

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✓ Syntax

SQRT(number)

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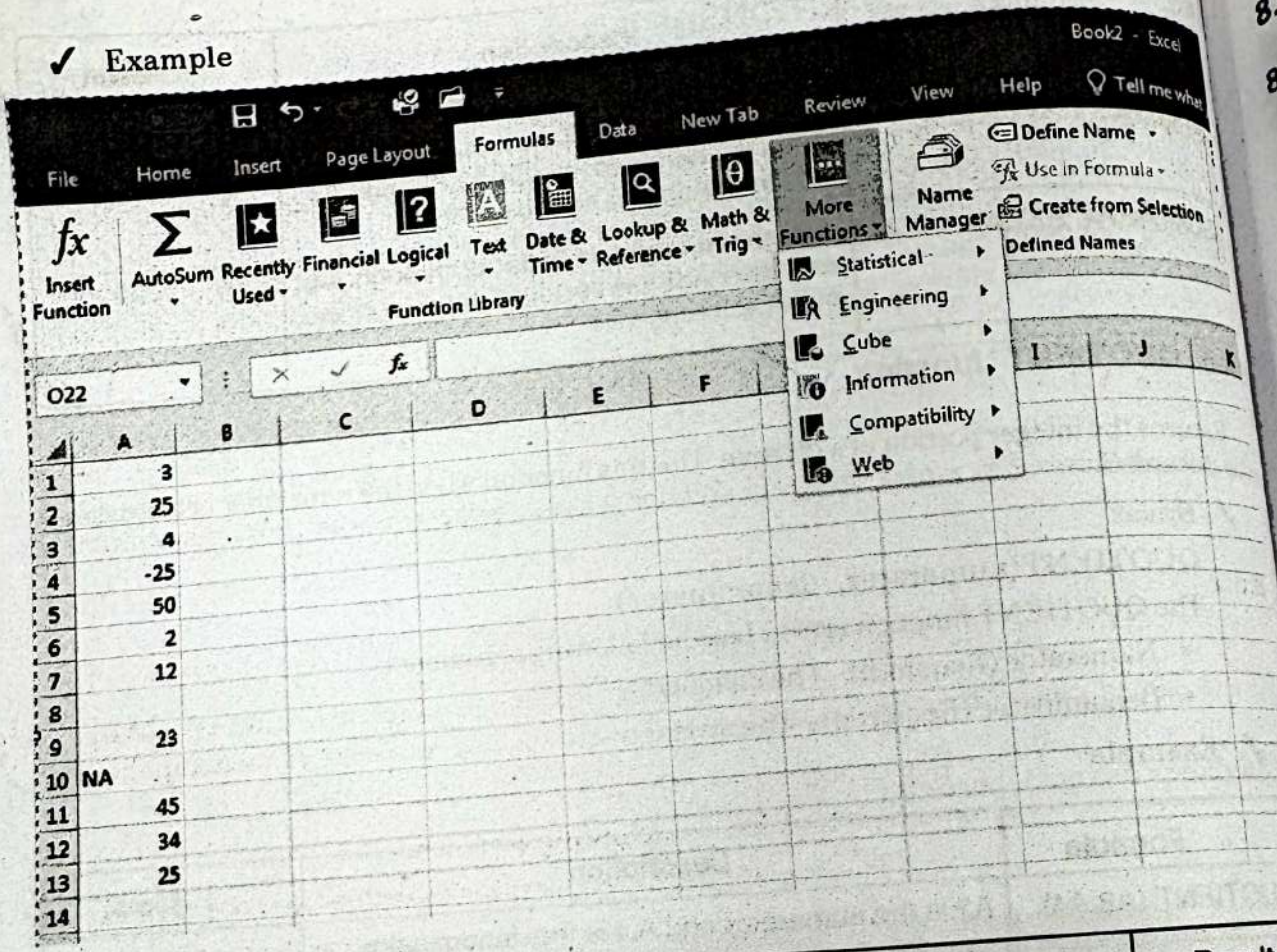
- Number (Required) - The number for which the square root is need to be done.

✓ Example


Book2 - Excel
File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell me what
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
More Functions
Function Library
Name Manager
Define Name
Use in Formula
Create from Selection
Defined Names
Statistical
Engineering
Cube
Information
Compatibility
Web
O22
A
B
C
D
E
F
I
J
K

	A
1	3
2	25
3	4
4	-25
5	50
6	2
7	12
8	
9	23
10	NA
11	45
12	34
13	25
14	

Formula	Description	Result
=SQRT(A2)	Square root of 25	5
= SQRT(A4)	Square root of -25. Because the number is negative, the #NUM! error message is returned.	#NUM!
=SQRT(ABS(A4))	Avoiding the #NUM! error message by first using the ABS function to find the absolute value of -16 and then finding the square root.	5

D > Date
3 8-12-2008
4 19
5 22.24
6 True
7 # Num #div/0!
formula

8.5 STATISTICAL FUNCTIONS

8.5.1 COUNT

✓ **Function :** The COUNT function counts the number of cells that contain numbers, and counts numbers within the list of arguments.

= COUNT(A2 : A7)

Use the COUNT function to get the number of entries in a number field that is in a range or array of numbers.

= 3

✓ **Syntax :** COUNT (value1, [value2], ...)

= COUNT (A5 : A7)
= 0

The COUNT function syntax has the following arguments:

- Value1 (Required) The first item, cell reference, or range within which one want to count numbers.
- Value2(Optional) Up to 255 additional items, cell references, or rangeswithin which one want to count numbers.

will not count empty cell.

8.5.2 COUNTA

✓ **Function :** The COUNTA ,(i.e. Count all)function counts the number of cells that are not empty in a range. It counts even if there is any text or special character in the array.

✓ **Syntax :** COUNTA (value1, [value2], ...)

= COUNTA( )
= 6

The COUNTA function syntax has the following arguments:

- Value1 (Required) The first argument representing the values that one want to count
- Value2 (Optional) Additional arguments representing the values that onewant to count, up to maximum of 255 arguments.

as you make any cell empty count a change

8.5.3 COUNTBLANK

✓ **Function :** The COUNTBLANK function counts the number of empty cells in a range of cells.

✓ **Syntax :** COUNTBLANK (Range)

6
4

27
34

The COUNTBLANK function syntax has the following arguments:

- Range (Required) The range for which one want to count the blank cells.

delete any as U changes.

= COUNT Blank (Rnge)
2

8.5.4 COUNTIF

✓ **Function :** The COUNTIF function counts the number of cells that meet acriterion. COUNTIF can be used to count cells with dates,numbers, and text that match specific criterion.

✓ **Syntax :** COUNTIF (range, criteria)

apples
oranges
peaches
apples

countif > 25

= Count if(Rnge, "apples")

Make changes in orange & write apple, it will show 3 apples you can write or you can select a cell where app in write

The COUNTIF function syntax has the following arguments:

- **Range** (Required) The range to evaluate.
- **Criteria** (Required) The criteria to use on range.

ID Name Marks
101 66
102 97
103 77
104 88
105 44
106 55
107 77
= Max(Range)
= 88

8.5.5 MAX

✓ **Function :** Returns the largest value in a set of values.

✓ **Syntax ;** MAX (number1, [number2], ...)

The MAX function syntax has the following arguments:

- Number1(Required)
- Number2- 255 (Optional) 1 TO 255 numbers for which one want to find the maxi value.

8.5.6 MIN

= Min(____)
= ____

✓ **Function :** Returns the smallest value in a set of values.

✓ **Syntax :** MIN (number1, [number2], ...)

The MIN function syntax has the following arguments:

- Number1(Required)
- Number2- 255 (Optional) 1 TO 255 numbers for which one want to find the mini value.

8.5.7 AVERAGE

✓ **Function :** Returns the average (arithmetic mean) of the arguments.

✓ **Syntax :** AVERAGE (number1, [number2], ...)

The AVERAGE function syntax has the following arguments:

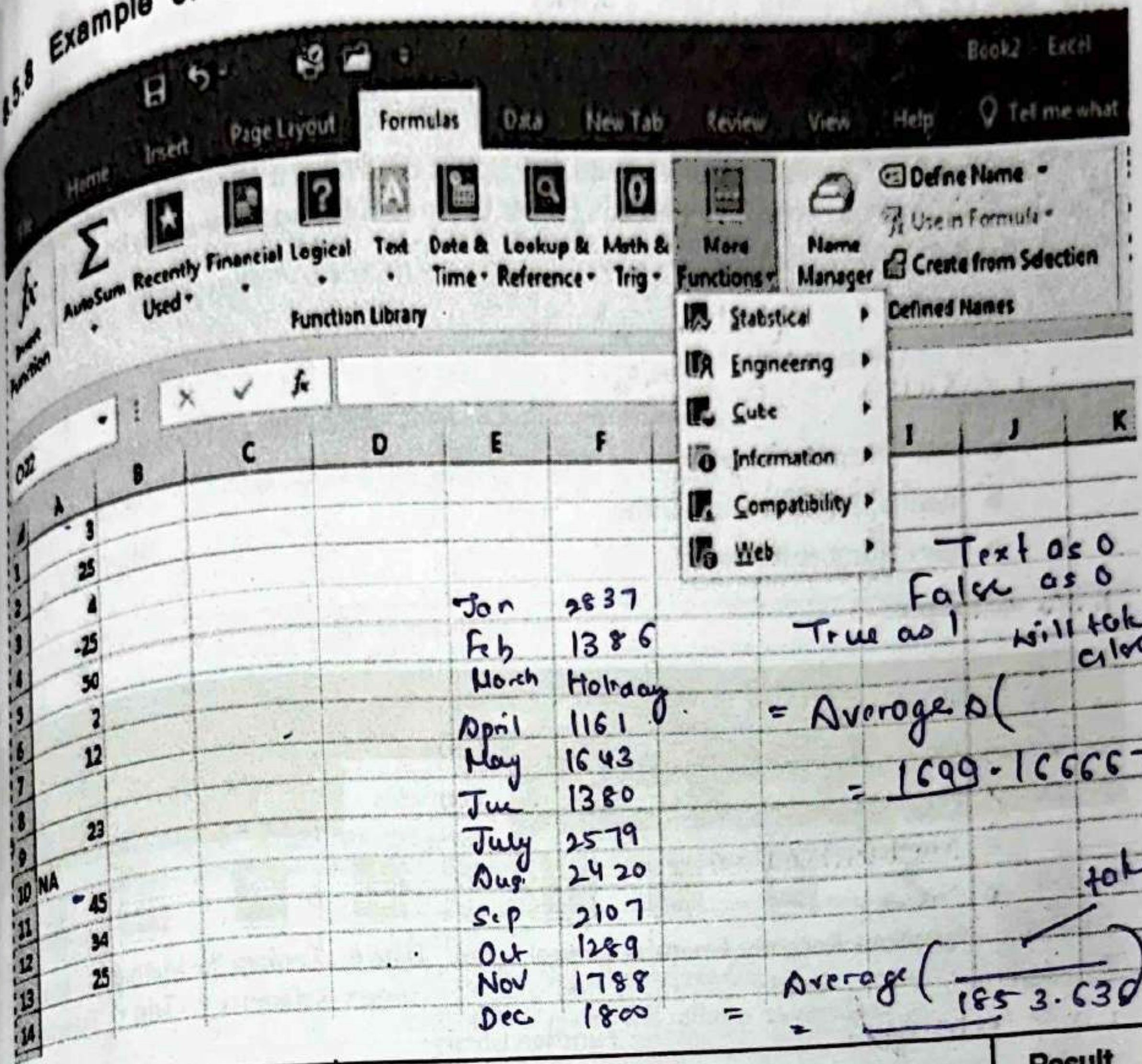
- Number1 (Required) The first number, cell reference, or range for which on the average.
- Number2- 255 (Optional) Additional numbers, cell references, or ranges for one want the average, up to a maximum of 255.

= average(____

0.25
0.88
MaxA = Maxa(—) man — 0
= 1
0.23
0.38
True value (1)
False (0)

3 4 5

8.5.8 Example of all Statistical Functions


Book2 - Excel
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Tell me what
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
More Functions
Name Manager
Define Name
Use in Formula
Create from Selection
Function Library
Defined Names
Statistical
Engineering
Cube
Information
Compatibility
Web
O22
A
B
C
D
E
F
I
J
K
1
2
3
4
5
6
7
8
9
10
11
12
13
14
3
25
4
-25
50
2
12
23
NA
45
34
25

Jan	2837
Feb	1386
March	Holiday
April	1161
May	1643
Jun	1380
July	2579
Aug	2420
Sep	2107
Oct	1289
Nov	1788
Dec	1800

Text as 0
False as 0
True as 1

will take text also

= AverageA( ) this case 12 month

= 1699.166667

takes 11 month not 12

= Average( ) = 1853.636

Formula	Description	Result
=COUNT(A1:A13)	Counts all the numeric values in the data excluding blanks	12
=COUNTA(A1:A13)	Counts all the numeric and text values in the data excluding blanks	13
=COUNTBLANK(A1:A13)	Counts all the blank cells	1
=MAX(A1:A13)	Maximum number of the range will be the output	50
=MIN(A1:A13)	Minimum number of the range will be the output	−25
=AVERAGE(A1:A13)	Gives the average of the range as output	18
=COUNTIF(A1:A13, ">25")	Counts all the numeric values that are greater than	3

8.6 DATE AND TIME FUNCTIONS

(Excel file creatio)

8.6.1 DATE function

The Excel DATE function creates a valid date from individual year, month, and day compo
The DATE function is useful for assembling dates that need to change dynamically based on
values in a worksheet.

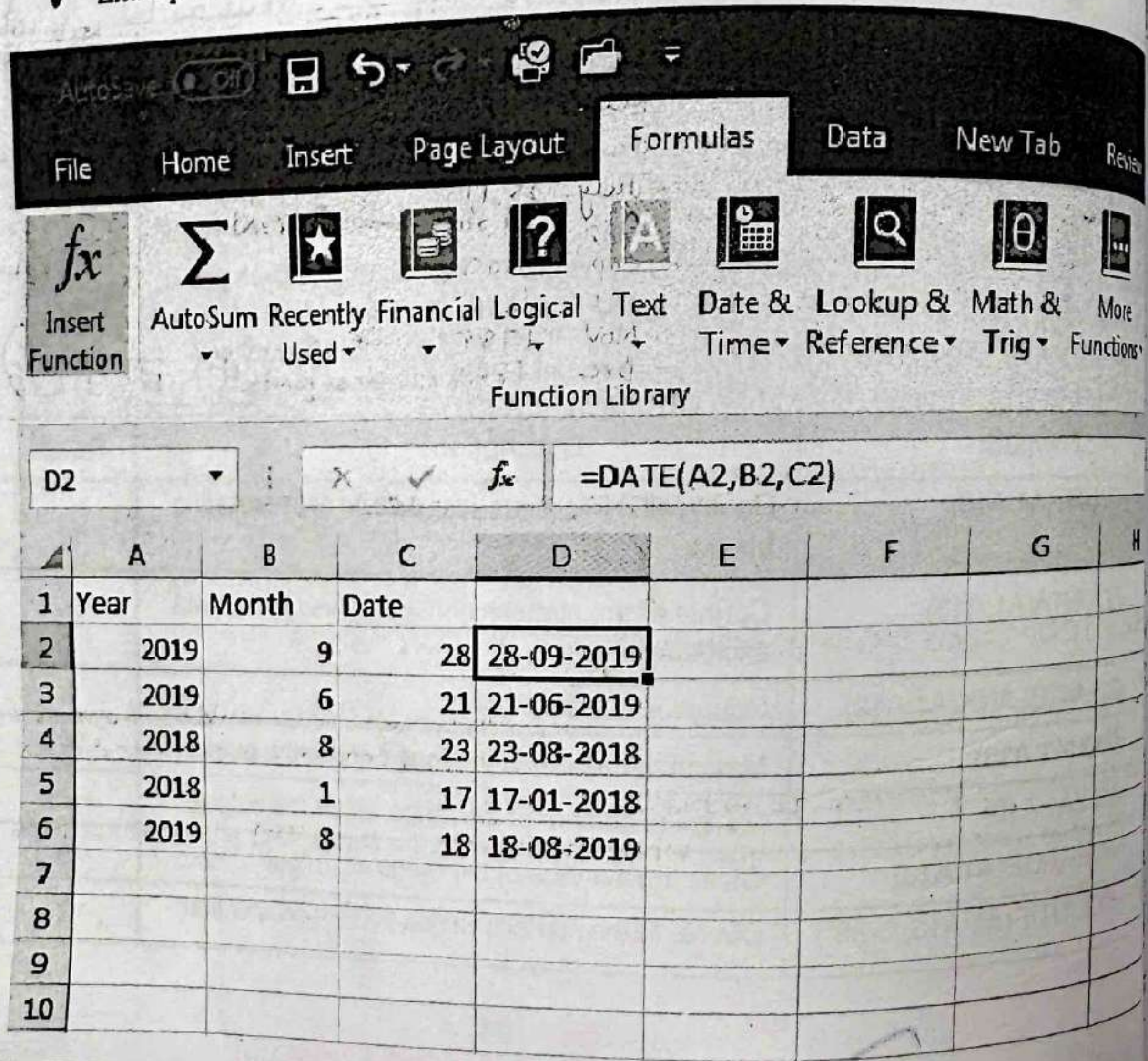
✓ **Syntax:**

=DATE (year, month, day)

Arguments

- year - Number for year.
- month - Number for month.
- day - Number for day.

✓ **Example:**


AutoSave Off
File
Home
Insert
Page Layout
Formulas
Data
New Tab
Revi
Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
More Functions
Function Library
D2

=DATE(A2,B2,C2)

	A	B	C	D	E	F	G
1	Year	Month	Date				
2	2019	9	28	28-09-2019			
3	2019	6	21	21-06-2019			
4	2018	8	23	23-08-2018			
5	2018	1	17	17-01-2018			
6	2019	8	18	18-08-2019			
7							
8							
9							
10							

8.6.2 TIME function

The Excel TIME function is a built-in function that allows to create a time with individual hour, minute, and second components. The TIME function is useful when onewant to assemble a proper time inside another formula.

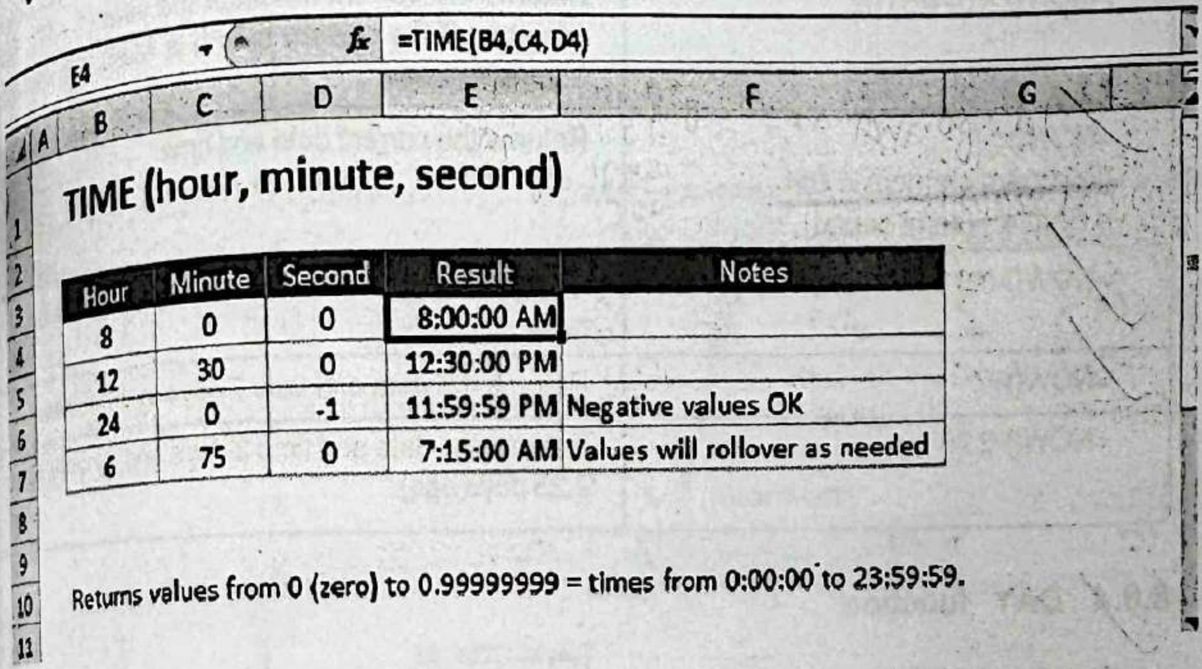
✓ Syntax

=TIME (hour, minute, second)

Arguments

- hour - The hour for the time one wish to create.
- minute - The minute for the time one wish to create.
- second - The second for the time one wish to create.

✓ Example



=TIME(B4,C4,D4)

TIME (hour, minute, second)

Hour	Minute	Second	Result	Notes
8	0	0	8:00:00 AM	
12	30	0	12:30:00 PM	
24	0	-1	11:59:59 PM	Negative values OK
6	75	0	7:15:00 AM	Values will rollover as needed

Returns values from 0 (zero) to 0.99999999 = times from 0:00:00 to 23:59:59.

8.6.3 TODAY and NOW function

A date or time that updates when the worksheet is recalculated, or the workbook is opened is considered "dynamic" instead of static. In a worksheet, the most common way to return a dynamic date or time in a cell is by using a worksheet function.

To insert the current date or time so that it is updatable, use the TODAY and NOW functions

Formula	Description
=TODAY() (keyboard shortcut is Ctrl + ; (semi-colon))	Returns the current date
=TODAY()+5	Returns the current date plus 5 days. For example, i the current date is 1/1/2012, this formula returns 1/6/ 2012.
=DATEVALUE("1/1/2030")-TODAY()	Returns the number of days between the current da and 1/1/2030. Note that target cell must be formatte as General or Number for the result to displa correctly.
=DAY(TODAY())	Returns the current day of the month (1 - 31).
=MONTH(TODAY())	Returns the current month of the year (1 - 12). Fo example, if the current month is May, this formula returns 5.
=NOW() (keyboard shortcut is Ctrl + Shift + ; (semi-colon))	Returns the current date and time.
=NOW()-0.5	Returns the date and time 12 hours ago (-0.5 day ago).
=NOW()+7	Returns the date and time 7 days in the future.
=NOW()-2.25	Returns the date and time 2 days and 6 hours ago 2.25 days ago).

8.6.4 DAY function

The Excel DAY function returns the day of the month as a number between 1 to 31 from given date. The DAY function can be used to extract a day number from a date into a cell number (1-31) representing the day component in a date is the return value.

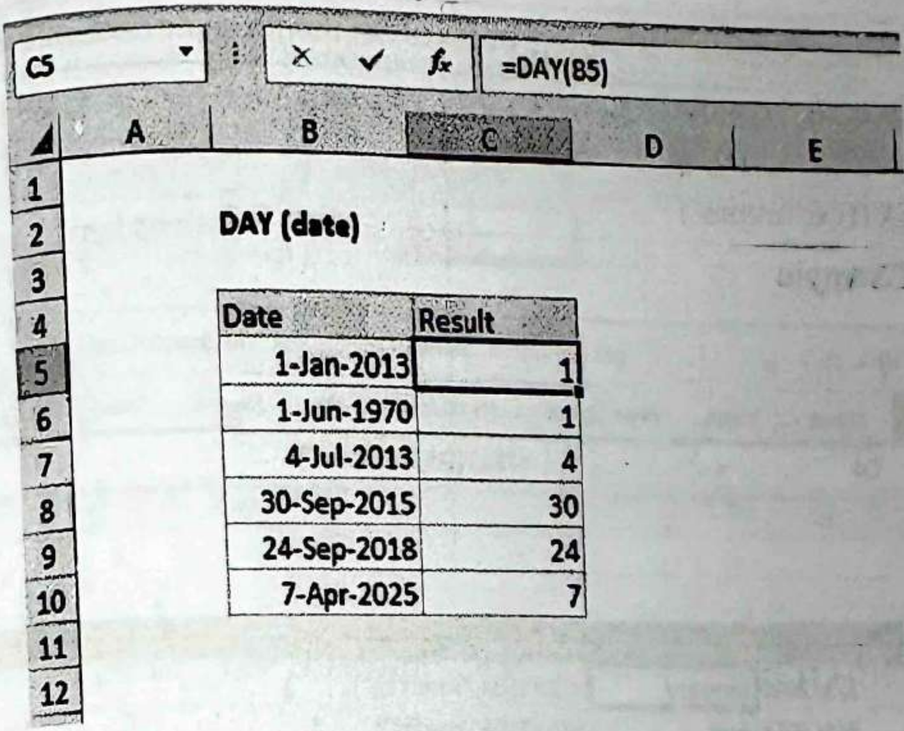
✓ **Syntax**

=DAY (date)

Arguments

- date - A valid Excel date.

✓ Example



DAY (date)

Date	Result
1-Jan-2013	1
1-Jun-1970	1
4-Jul-2013	4
30-Sep-2015	30
24-Sep-2018	24
7-Apr-2025	7

8.6.5 MONTH function

The Excel MONTH function extracts the month from a given date as number between 1 to 12.

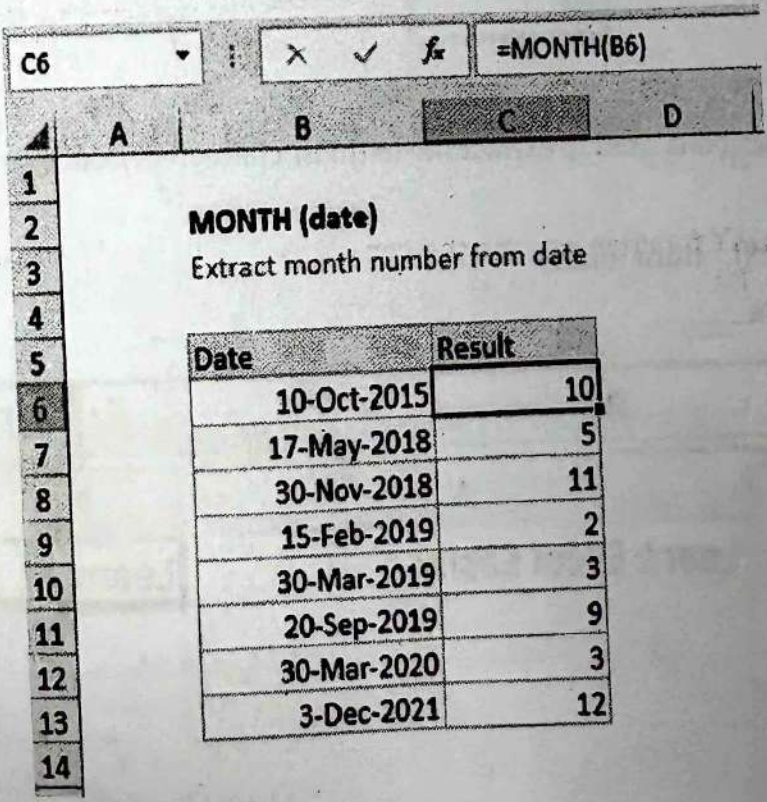
✓ Syntax

=MONTH (date)

Arguments

- date - A valid Excel date.

✓ Example



MONTH (date)

Extract month number from date

Date	Result
10-Oct-2015	10
17-May-2018	5
30-Nov-2018	11
15-Feb-2019	2
30-Mar-2019	3
20-Sep-2019	9
30-Mar-2020	3
3-Dec-2021	12

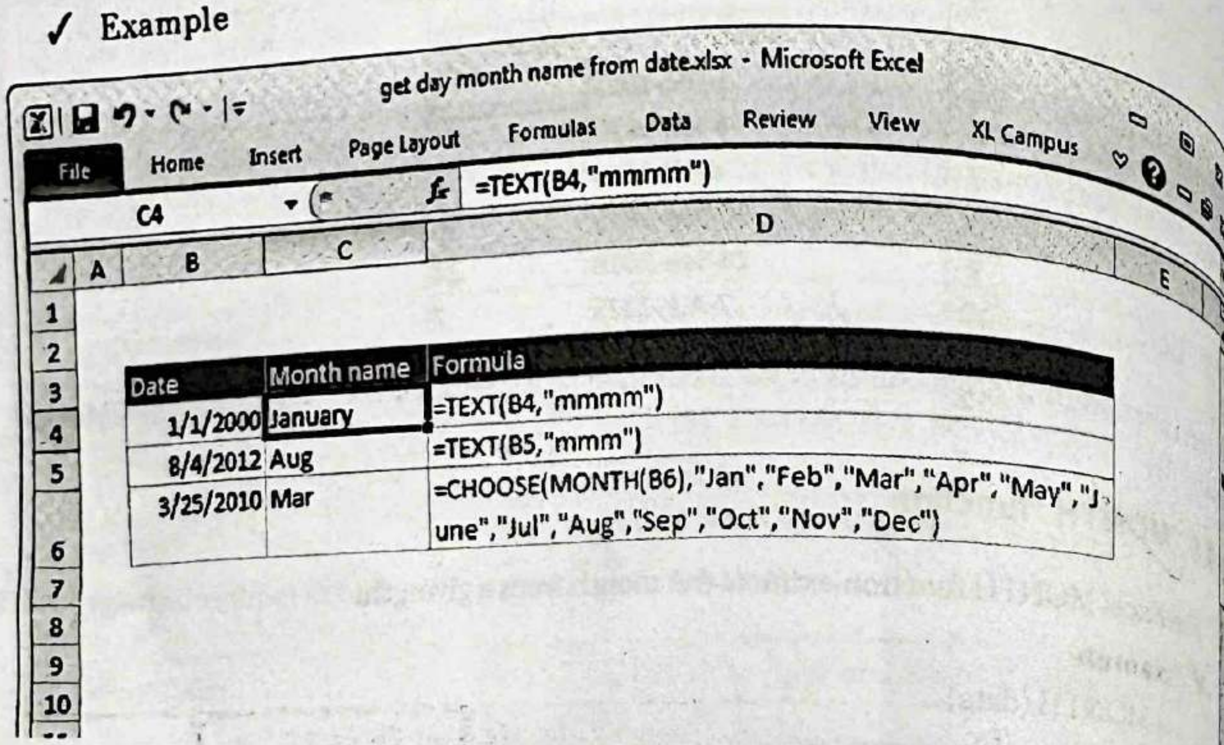
If instead of numeric value, one wants to Get month name from date, the syntax is as follo

=TEXT(C6, "mmmm")

Or

=TEXT(C6, "mmm")

✓ Example


get day month name from date.xlsx - Microsoft Excel
File
Home
Insert
Page Layout
Formulas
Data
Review
View
XL Campus
C4
A
B
C
D
E
1
2
3
4
5
6
7
8
9
10

=TEXT(B4,"mmmm")

Date	Month name	Formula
1/1/2000	January	=TEXT(B4,"mmmm")
8/4/2012	Aug	=TEXT(B5,"mmm")
3/25/2010	Mar	=CHOOSE(MONTH(B6),"Jan","Feb","Mar","Apr","May","June","Jul","Aug","Sep","Oct","Nov","Dec")

8.7 TEXT functions

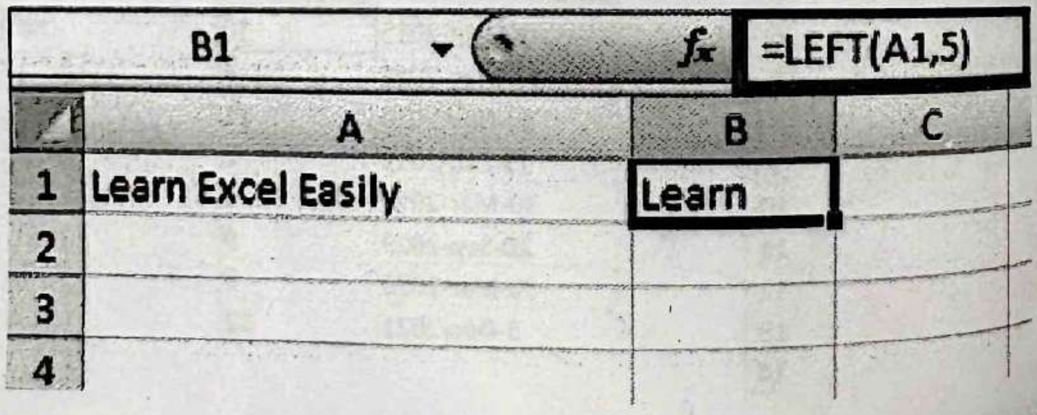
8.7.1 Left ()

The Left function is used to extract the leftmost characters from a string.

✓ Syntax

=left(text, num_char)

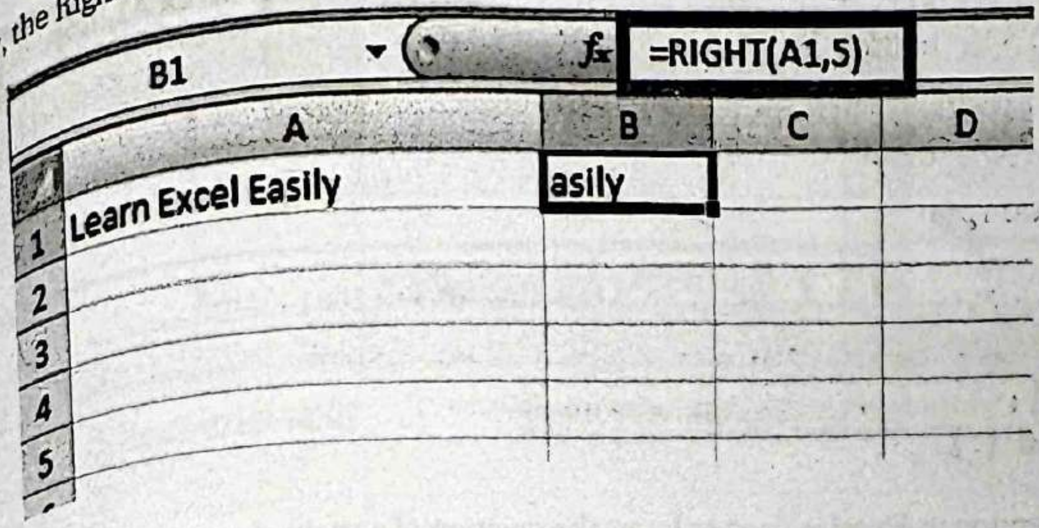
✓ Example



=LEFT(A1,5)

A	B
Learn Excel Easily	Learn

Similarly, the Right function is used to extract the rightmost characters from a string.



=RIGHT(A1,5)

	A	B	C	D
1	Learn Excel Easily	asily		
2				
3				
4				
5				

8.7.2 Len ( )

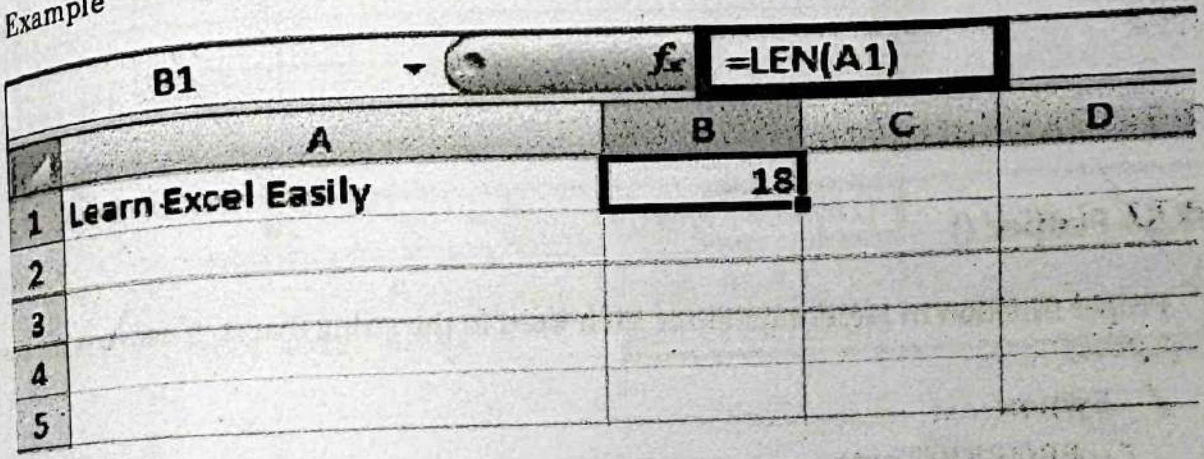
Len function in Excel helps to know the length of a string that is number of characters in a string.

✓ Syntax

= LEN(text)

Note – Spaces are included while calculating length.

✓ Example



=LEN(A1)

	A	B	C	D
1	Learn Excel Easily	18		
2				
3				
4				
5				

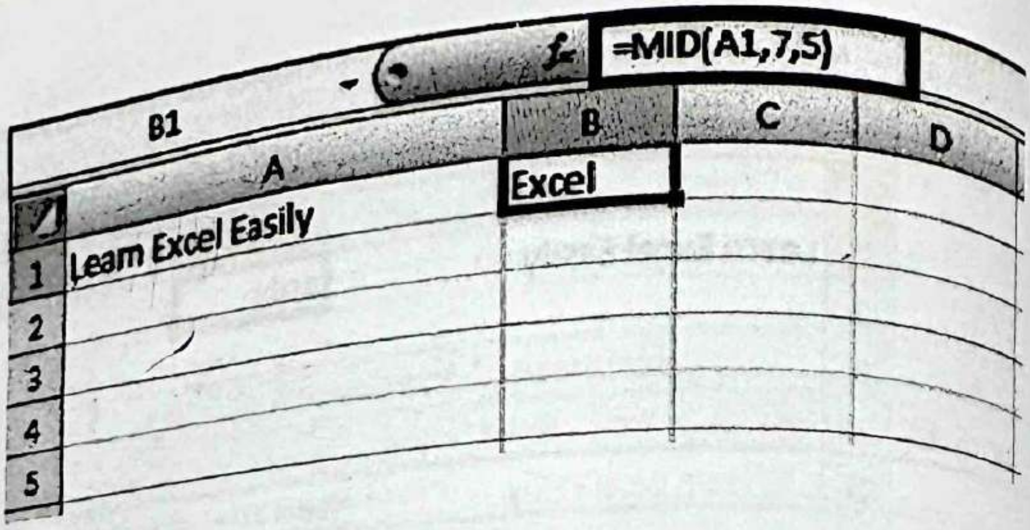
8.7.3 Mid ( )

Mid function in Excel is used to extract the characters from the middle of a string.

✓ Syntax

= MID(text, start_char, num_chars)

- Example



=MID(A1,7,5)

	A	B
1	Learn Excel Easily	Excel

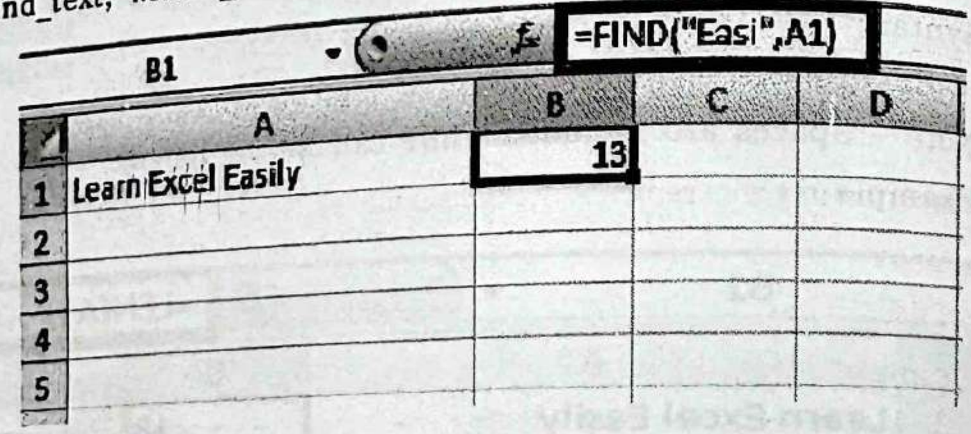
8.7.4 Find ( )

Find function in Excel is used to know the position of certain characters in a particular string.

- Syntax

  =FIND(find_text, within_text,[start_num])

- Example



=FIND("Easi",A1)

	A	B
1	Learn Excel Easily	13

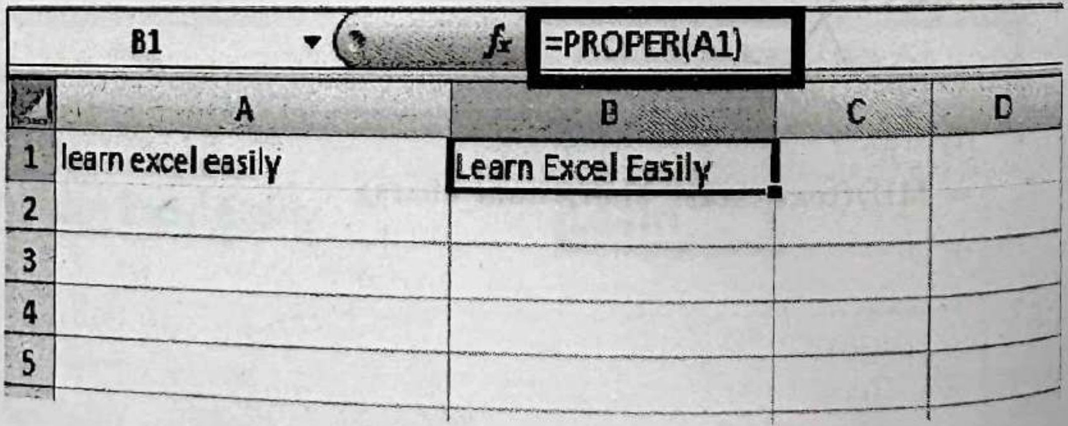
8.7.5 Proper ()

Proper function in Excel capitalizes each word in the string that is, it converts the case into proper case.

- Syntax

  =PROPER(Text)

- Example



=PROPER(A1)

	A	B
1	learn excel easily	Learn Excel Easily

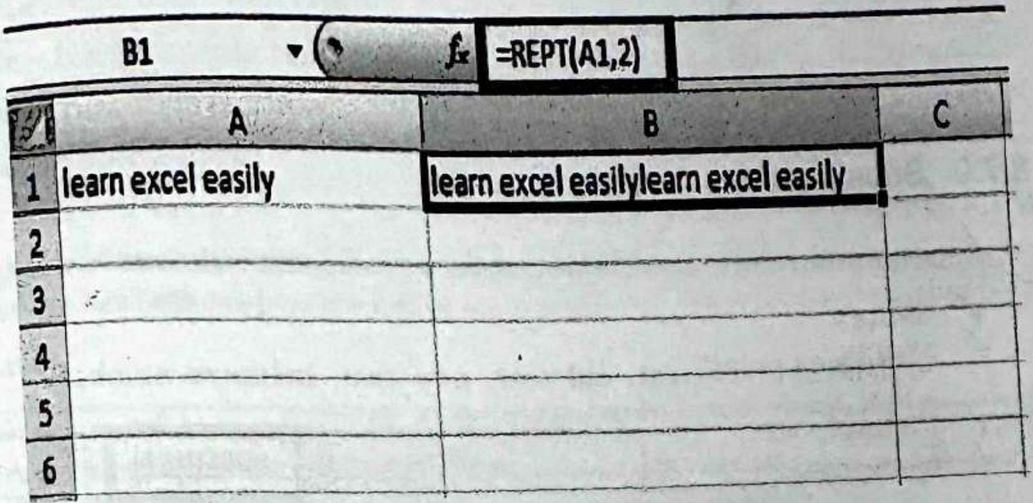
8.7.6 Rept ( )

Rept function in Excel is used when a certain text to be repeated certain number of times.

- Syntax

  =REPT(Text, number_times)

- Example



B1 =REPT(A1,2)

	A	B	C
1	learn excel easily	learn excel easilylearn excel easily	
2			
3			
4			
5			
6			

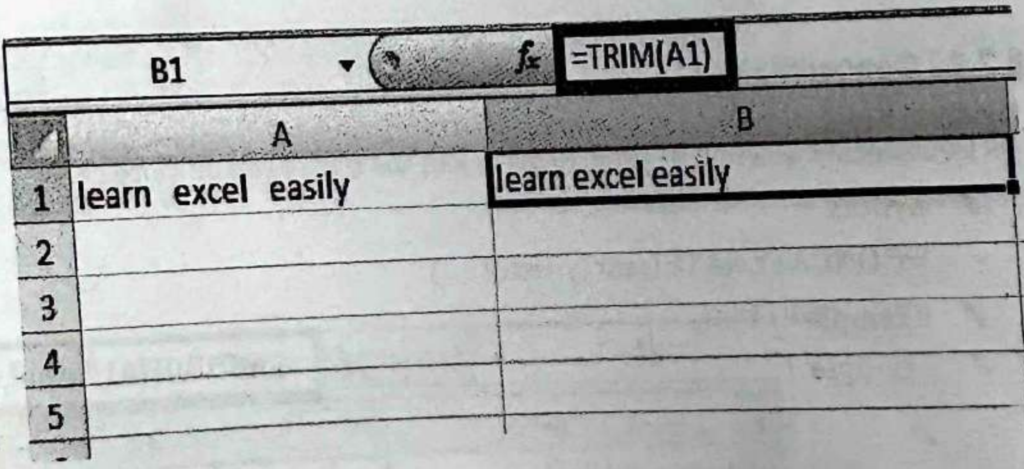
8.7.7 Trim ( )

Trim function in Excel removes the unnecessary spaces from a particular string.

- Syntax

  =TRIM(Text)

- Example



B1 =TRIM(A1)

	A	B
1	learn excel easily	learn excel easily
2		
3		
4		
5		

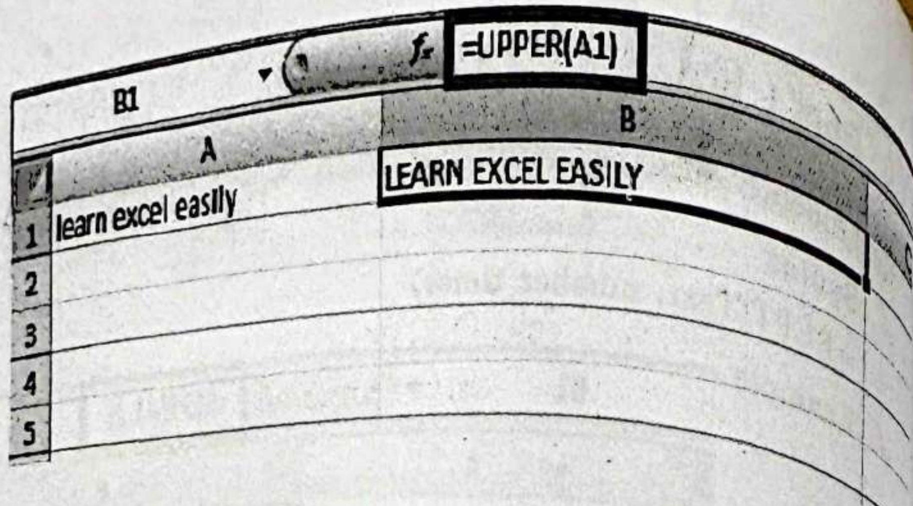
8.7.8 Upper()

Upper function in Excel converts the text into Upper case from lower case.

- Syntax

  =UPPER(Text)

✓ Example



=UPPER(A1)

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LEARN EXCEL EASILY

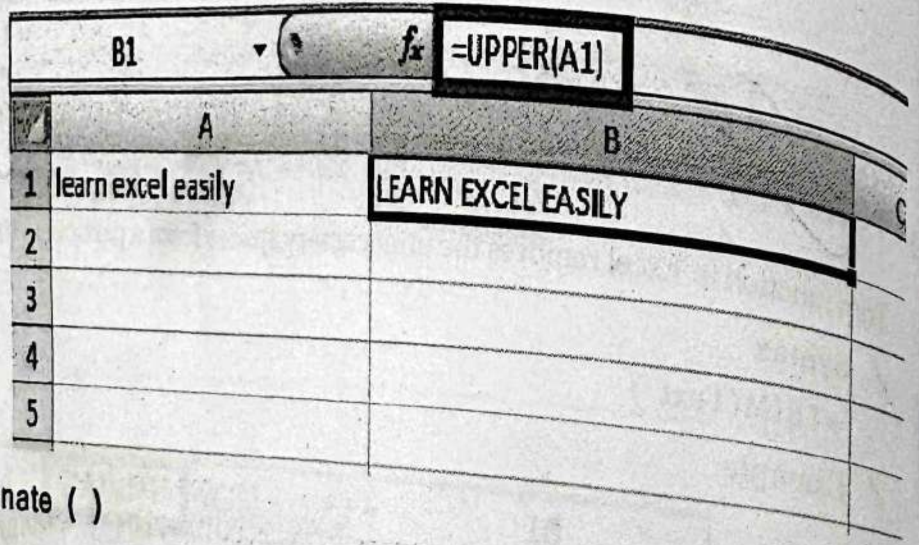
8.7.9 Substitute ( )

Substitute function in Excel helps to replace existing text with a new text in a particular string

✓ Syntax

=SUBSTITUTE(text, old_text, new_text, instance number)

✓ Example



=UPPER(A1)

learn excel easily

LEARN EXCEL EASILY

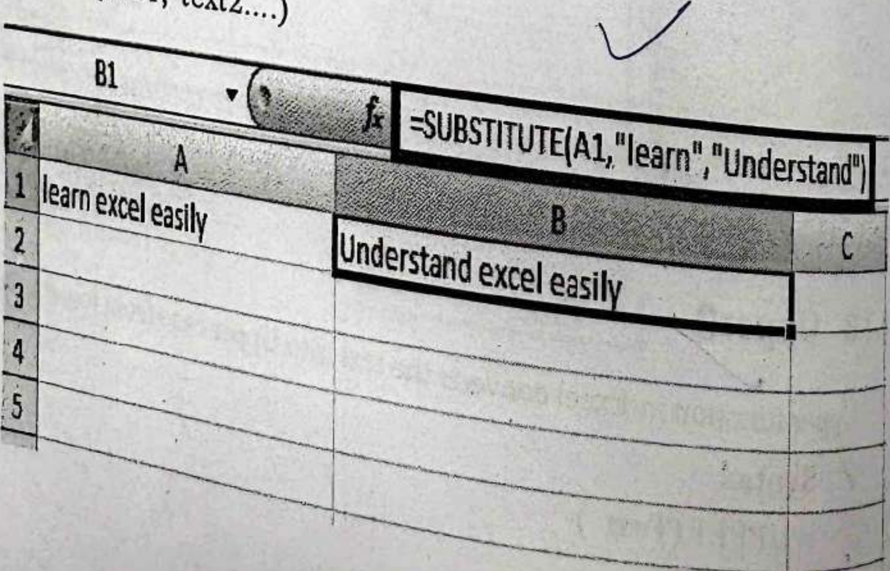
8.7.10 Concatenate ( )

Concatenate function in Excel helps to join the text of two or more cells.

✓ Syntax

=CONCATENATE(text1, text2....)

✓ Example



=SUBSTITUTE(A1,"learn","Understand")

learn excel easily

Understand excel easily

FINANCIAL FUNCTION IN EXCEL

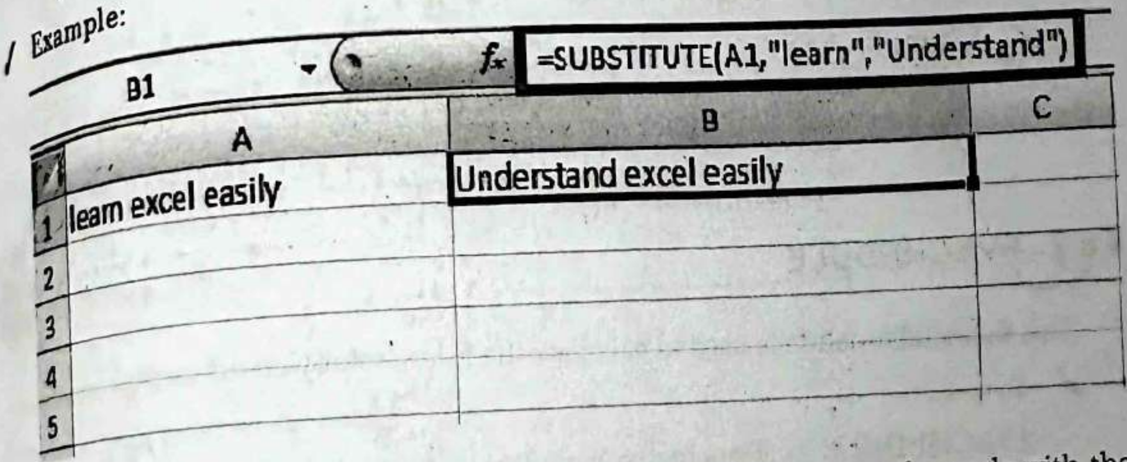
Future Value (FV)

Syntax:

=FV (Rate, Nper, [Pmt], PV, [Type])

- Rate = It is the interest rate/period
- Nper = Number of periods
- Pmt= Payment/period
- PV = Present Value
- Type = When the payment is made (if nothing is mentioned, it's assumed that the payment has been made at the end of the period)

Example:



B1

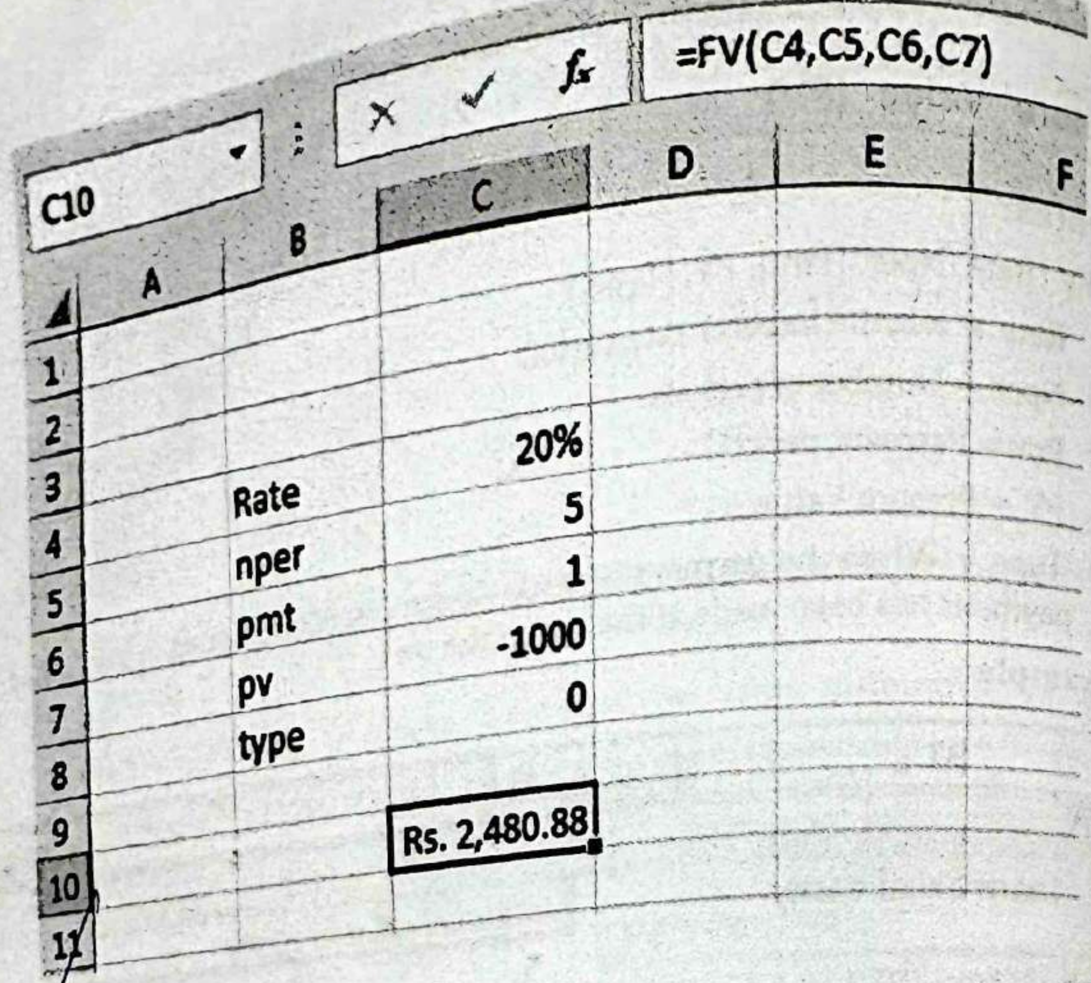
=SUBSTITUTE(A1,"learn","Understand")

	A	B	C
1	learn excel easily	Understand excel easily	
2			
3			
4			
5			

If a person has invested Rs 1000 in 2014 and the payment has been made yearly with the interest rate of 20% per annum, the Future Value in 2019 will be as follows:

= FV (C4, C5, C6, C7)

= Rs 2,480.88



C10

=FV(C4,C5,C6,C7)

	A	B	C	D	E	F
1						
2						
3						
4		Rate	20%			
5		nper	5			
6		pmt	1			
7		pv	-1000			
8		type	0			
9						
10			Rs. 2,480.88			
11						

8.8.2 FVSCHEDULE

This financial function is used to calculate the future value with the variable interest rate.

✓ Syntax:

FVSCHEDULE = (Principal, Schedule)

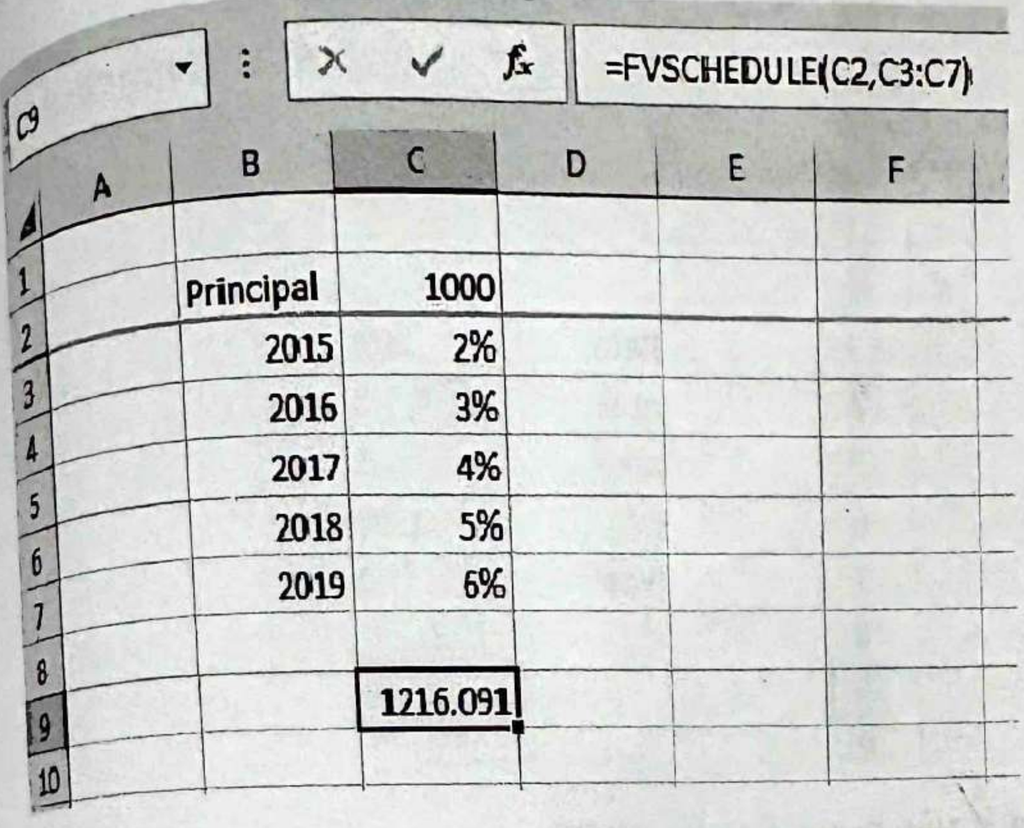
- Principal = Principal is the present value of a particular investment
- Schedule = A series of interest rate put together (in case of excel, different boxes will be used and select the range)

✓ Example:

If a person has invested Rs 1000 in 2014 and it is expected that the interest rate will change every year (in 2015, 2016, 2017, 2018 & 2019, the interest rates would be 2%, 3%, 4%, 6% & 5% respectively), the Future Value in 2019 will be as follows:

= FVSCHEDULE (C2, C3:C7)

=Rs 1216.091



=FVSCHEDULE(C2,C3:C7)

	A	B	C	D	E	F
1						
2		Principal	1000			
3		2015	2%			
4		2016	3%			
5		2017	4%			
6		2018	5%			
7		2019	6%			
8						
9			1216.091			
10						

113 Present Value (PV)

✓ Syntax:

PV = (Rate, Nper, [Pmt], FV, [Type])

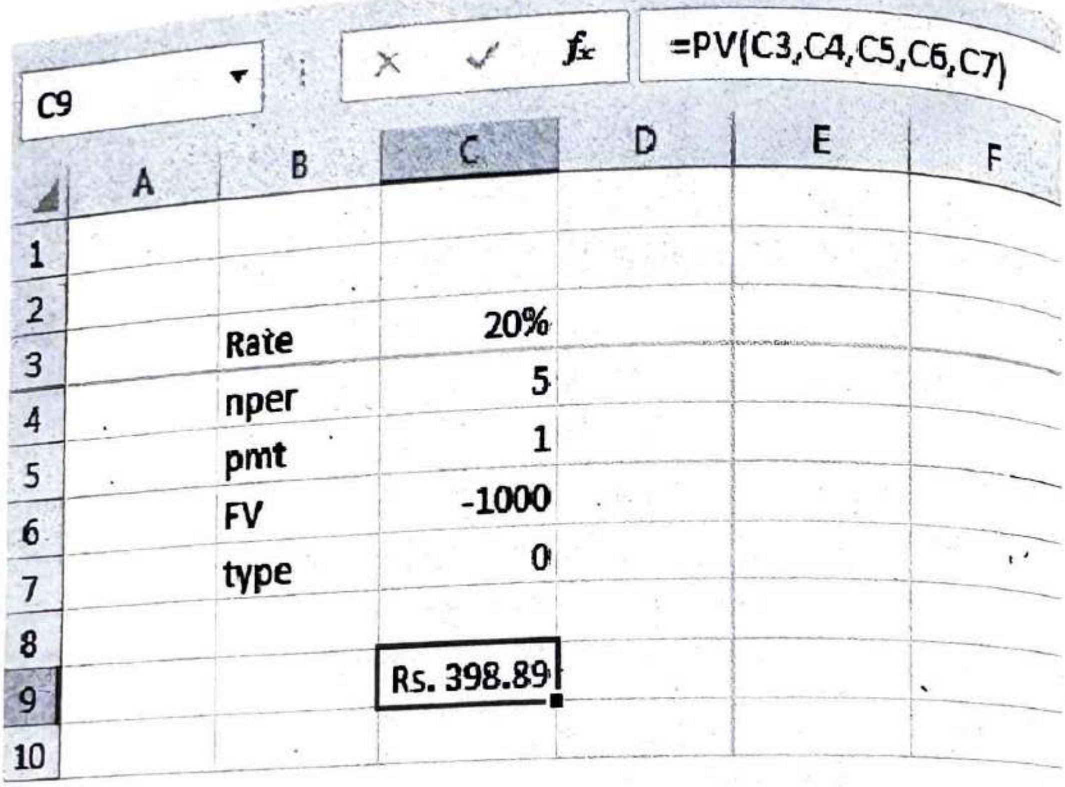
- Rate = It is the interest rate/period
- Nper = Number of periods
- Pmt = Payment/period
- FV = Future Value
- Type= When the payment is made (if nothing is mentioned, it's assumed that the payment has been made at the end of the period)

✓ Example:

The future value of an investment is Rs 1000 in 2024. The payment has been made yearly. The interest rate is 20% p.a. So, the Present value (in 2019) will be:

= PV (C3, C4, C5, C6, C7)

= Rs 398.89



C9 =PV(C3,C4,C5,C6,C7)

	A	B	C	D	E	F
1						
2						
3		Rate	20%			
4		nper	5			
5		pmt	1			
6		FV	-1000			
7		type	0			
8						
9			Rs. 398.89			
10						

8.8.4 Net Present Value (NPV)

Net Present Value is the sum total of positive and negative cash flows over the years.

✓ Syntax:

NPV = (Rate, Value 1, [Value 2], [Value 3]...)

- Rate = Discount rate for a period
- Value 1, [Value 2], [Value 3]... = Positive or negative cash flows
- Here, negative values would be considered as payments and positive values would be treated as inflows.

✓ Example:

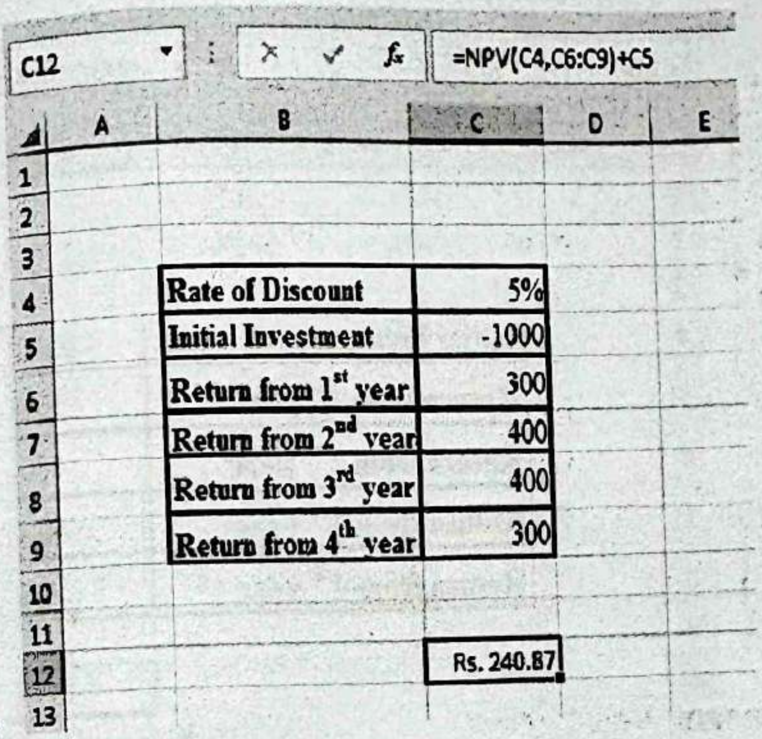
The series of data is as follows –

Details	In Rs
Rate of Discount	5%
Initial Investment	-1000
Return from 1st year	300
Return from 2nd year	400
Return from 3rd year	400
Return from 4th year	300

The NPV will be:

=NPV (C4, C6:C9) + C5

= Rs 240.87



C12 | =NPV(C4,C6:C9)+C5

	A	B	C	D	E
1					
2					
3					
4		**Rate of Discount**	5%		
5		**Initial Investment**	-1000		
6		**Return from 1st year**	300		
7		**Return from 2nd year**	400		
8		**Return from 3rd year**	400		
9		**Return from 4th year**	300		
10					
11					
12			Rs. 240.87		
13					

8.8.5 Internal Rate of Return (IRR)

To understand whether any new project or investment is profitable or not, firm uses IRR. If IRR is more than the hurdle rate (acceptable rate/ average cost of capital), then it's profitable for the firm and vice-versa.

✓ Syntax:

IRR = (Values, [Guess])

- Values = Positive or negative cash flows (an array of values)
- [Guess] = An assumption of what IRR should be

✓ Example:

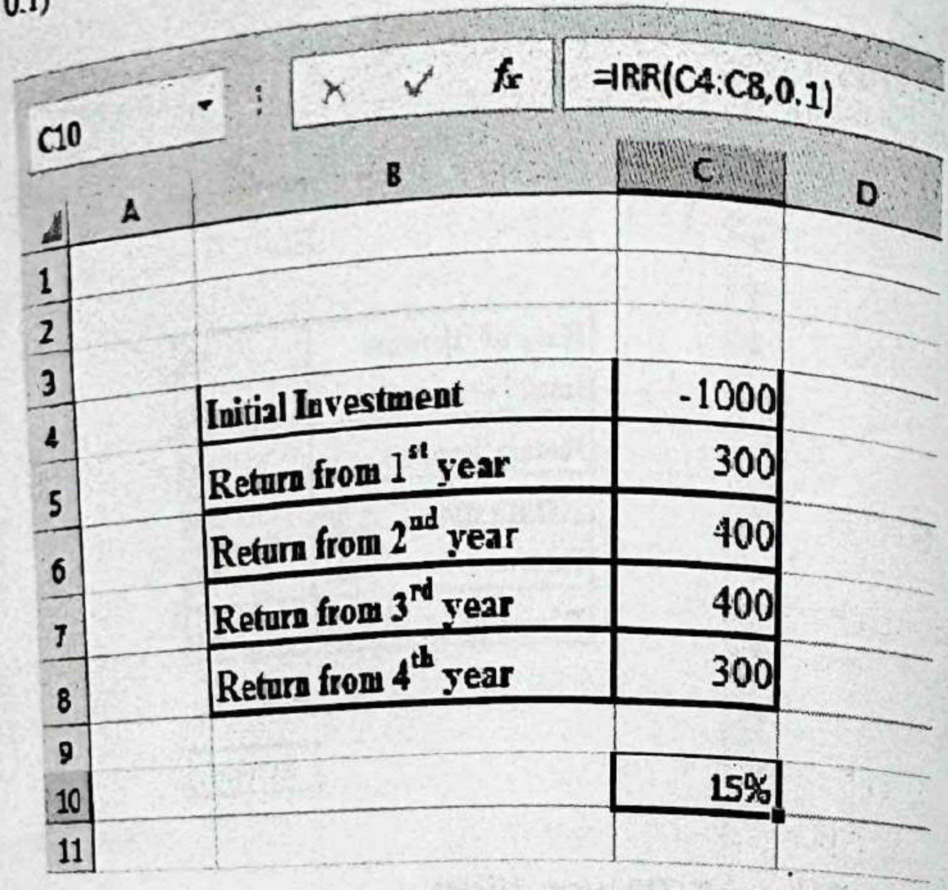
Here is the series of data:

Details	In Rs
Initial Investment	-1000
Return from 1st year	300
Return from 2nd year	400
Return from 3rd year	400
Return from 4th year	300

The IRR will be:

= IRR (C4:C8, 0.1)

= 15%



C10 =IRR(C4:C8,0.1)

	A	B	C	D
1				
2				
3		Initial Investment	-1000	
4		Return from 1st year	300	
5		Return from 2nd year	400	
6		Return from 3rd year	400	
7		Return from 4th year	300	
8				
9				
10			15%	
11				

8.8.6 NPER

It is simply the number of periods one requires to pay off the loan.

✓ Syntax:

NPER = (Rate, PMT, PV, [FV], [Type])

- Rate = It is the interest rate/period
- PMT = Amount paid per period
- PV = Present Value
- [FV] = An optional argument which is about the future value of a loan (if nothing is mentioned, FV is considered as "0")
- [Type] = When the payment is made (if nothing is mentioned, it's assumed that the payment has been made at the end of the period)

✓ Example:

Rs 200 is paid per year for a loan of Rs 1000. Interest rate is 10% p.a. and the payment needs to be done yearly. The NPER will be

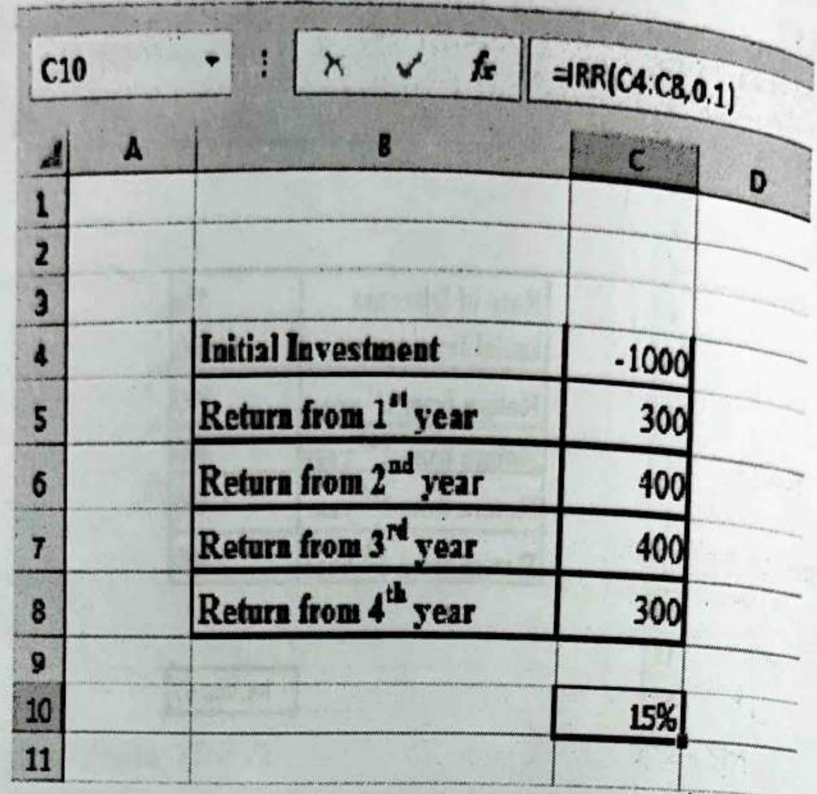
=NPER(C3, C4, C5)

=7.27 years

The IRR will be:

= IRR (C4:C8, 0.1)

= 15%



	A	B	C	D
1				
2				
3				
4		**Initial Investment**	-1000	
5		**Return from 1st year**	300	
6		**Return from 2nd year**	400	
7		**Return from 3rd year**	400	
8		**Return from 4th year**	300	
9				
10			15%	
11				

8.8.6 NPER

It is simply the number of periods one requires to pay off the loan.

✓ **Syntax:**

NPER = (Rate, PMT, PV, [FV], [Type])

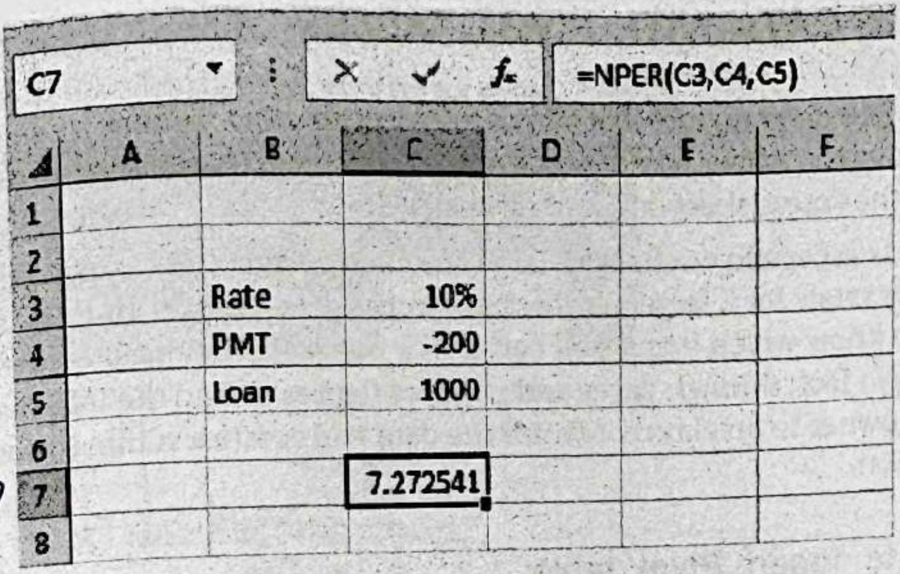
- Rate = It is the interest rate/period
- PMT = Amount paid per period
- PV = Present Value
- [FV] = An optional argument which is about the future value of a loan (if nothing mentioned, FV is considered as "0")
- [Type] = When the payment is made (if nothing is mentioned, it's assumed that th payment has been made at the end of the period)

✓ **Example:**

Rs 200 is paid per year for a loan of Rs 1000. Interest rate is 10% p.a. and the payment needs to be done yearly. The NPER will be

=NPER(C3, C4, C5)

=7.27 years



C7 | =NPER(C3,C4,C5)

	A	B	C	D	E	F
1						
2						
3		Rate	10%			
4		PMT	-200			
5		Loan	1000			
6						
7			7.272541			
8						

8.8.7 RATE

Through RATE function, the interest rate needed to pay to pay off the loan in full for a given period of time can be calculated.

✓ Syntax:

RATE = (NPER, PMT, PV, [FV], [Type], [Guess])

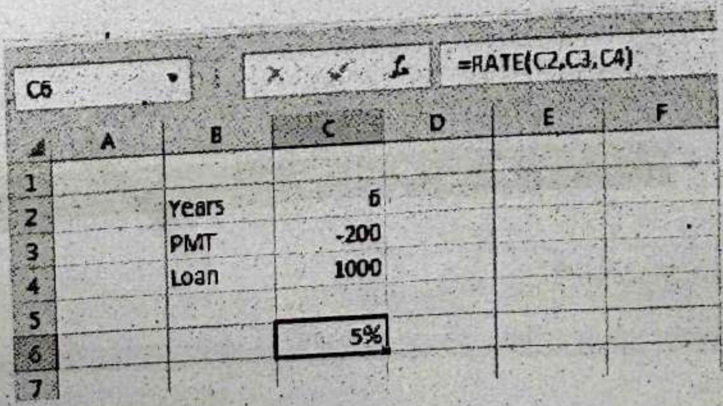
- Nper = Number of periods
- PMT = Amount paid per period
- PV = Present Value
- [FV] = An optional argument which is about the future value of a loan (if nothing is mentioned, FV is considered as "0")
- [Type] = When the payment is made (if nothing is mentioned, it's assumed that the payment has been made at the end of the period)
- [Guess] = An assumption of what RATE should be

✓ Example:

Rs 200 is paid per year for a loan of Rs 1000 for 6 years and the payment needs to be done yearly. The RATE will be

=RATE(C2,C3,C4)

=5%



C6 | =RATE(C2,C3,C4)

	A	B	C	D	E	F
1						
2		Years	6			
3		PMT	-200			
4		Loan	1000			
5						
6			5%			
7						

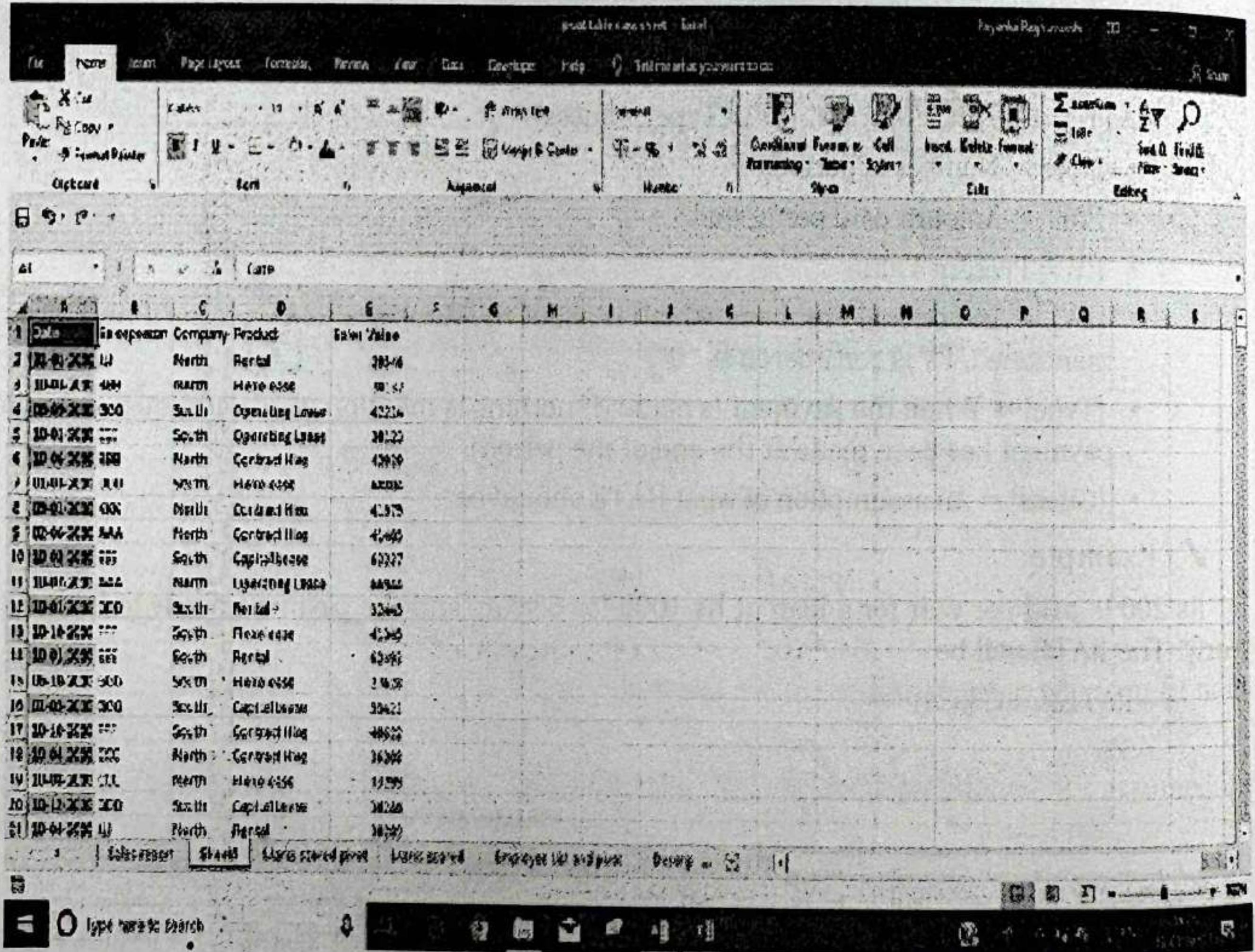
8.9 ANALYZE DATA WITH PIVOT TABLE

A pivot table is a program tool that allows to reorganize and summarize selected columns and rows of data in a spreadsheet or database table to obtain a desired report. A pivot table doesn't actually change the spreadsheet or database itself.

A pivot table is especially useful with large amounts of data. For example, a store owner might list monthly sales totals for a large number of merchandise items in an Excel spreadsheet. If the owner wanted to know which items sold better in a particular financial quarter, it would be very time-consuming to look through pages and pages of figures to find the information. A pivot table would allow the owner to quickly reorganize the data and create a summary for each item for the quarter in question.

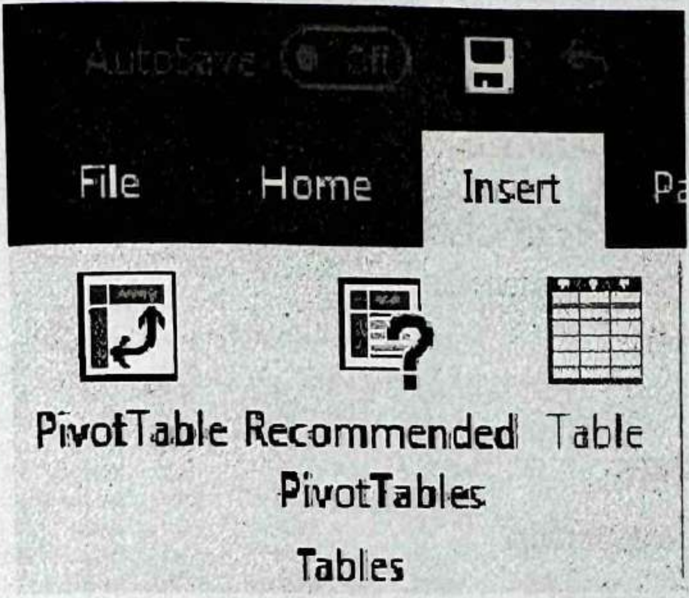
8.9.1 Steps to insert Pivot table

1. Click any single cell inside the data set.

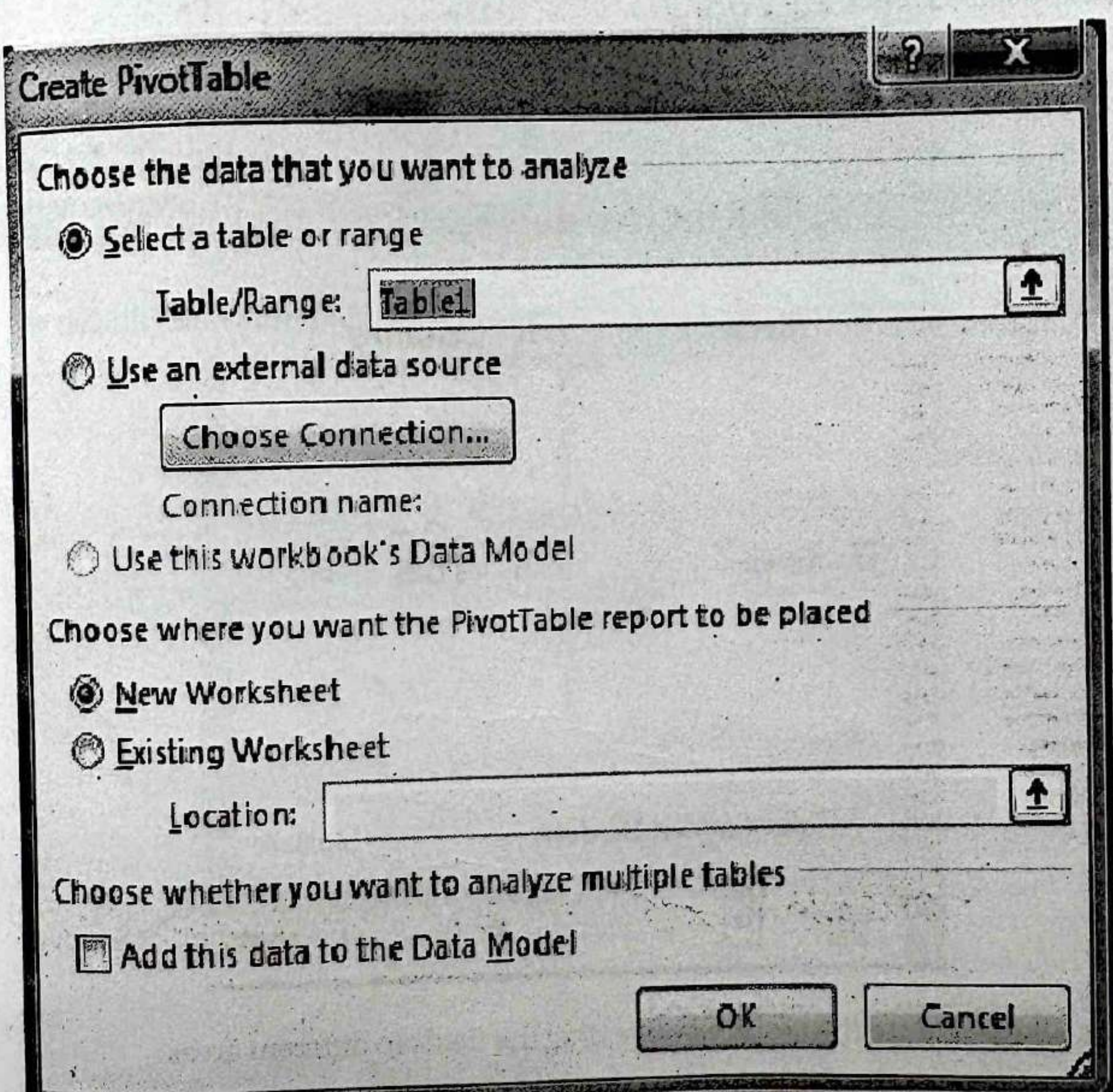

File
Home
Insert
Page Layout
Formulas
Data
Developer
Help
Clipboard
Font
Alignment
Number
Styles
Cells
Editing
Conditional Formatting
Format as Table
Cell Styles
Insert
Delete
Format
Sort & Filter
Find & Select
A1
Date
Salesperson
Company
Product
Sales Value
North
South
Rental
Capital lease
Operating Lease
Contract Hire
Sheet1

The above screenshot shows the normal data in excel.

2. On the insert tab, in the tables group, click pivot table.


AutoSave Off
File
Home
Insert
Pa
PivotTable
Recommended PivotTables
Table
Tables

3. The Pivot Table dialog box will appear. Select the data and click OK


Create PivotTable

Choose the data that you want to analyze

● Select a table or range

Table/Range: Table1

○ Use an external data source

Choose Connection...

Connection name:

○ Use this workbook's Data Model

Choose where you want the PivotTable report to be placed

● New Worksheet

○ Existing Worksheet

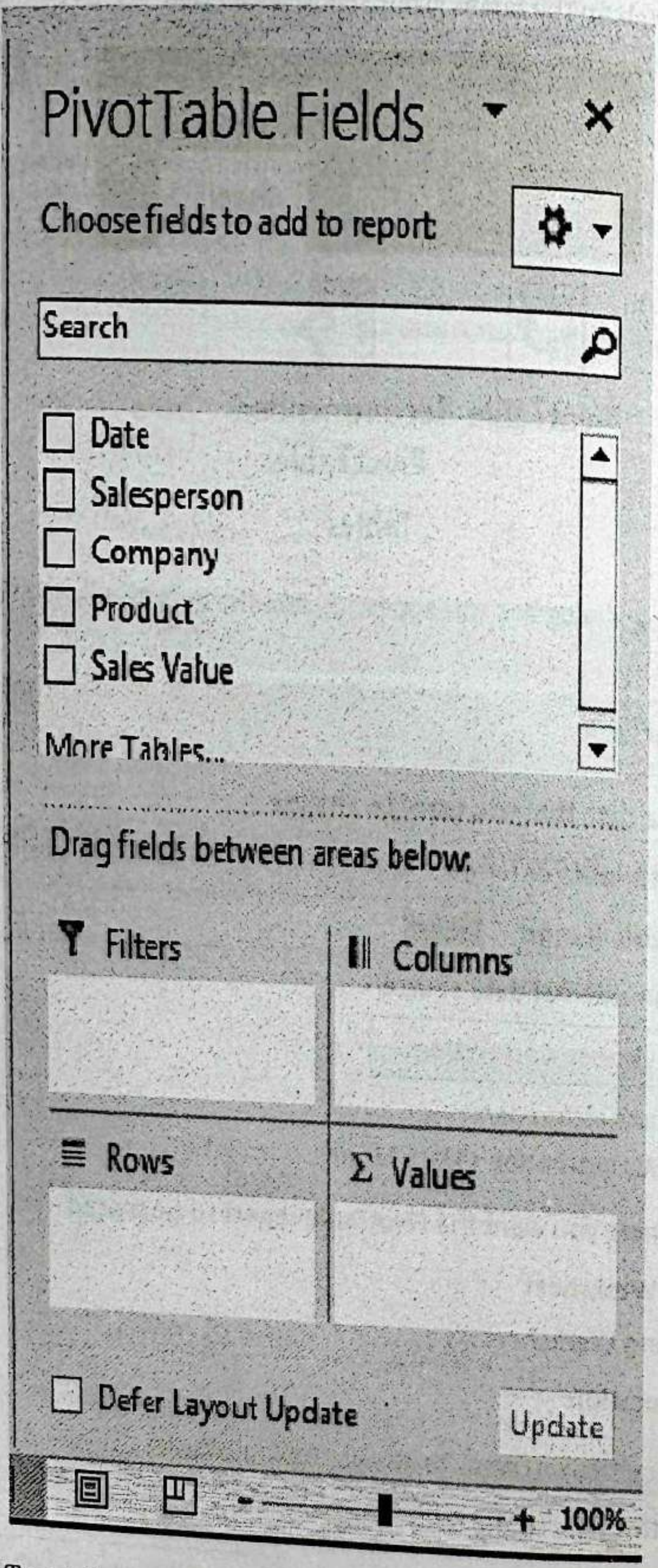
Location:

Choose whether you want to analyze multiple tables

☐ Add this data to the Data Model

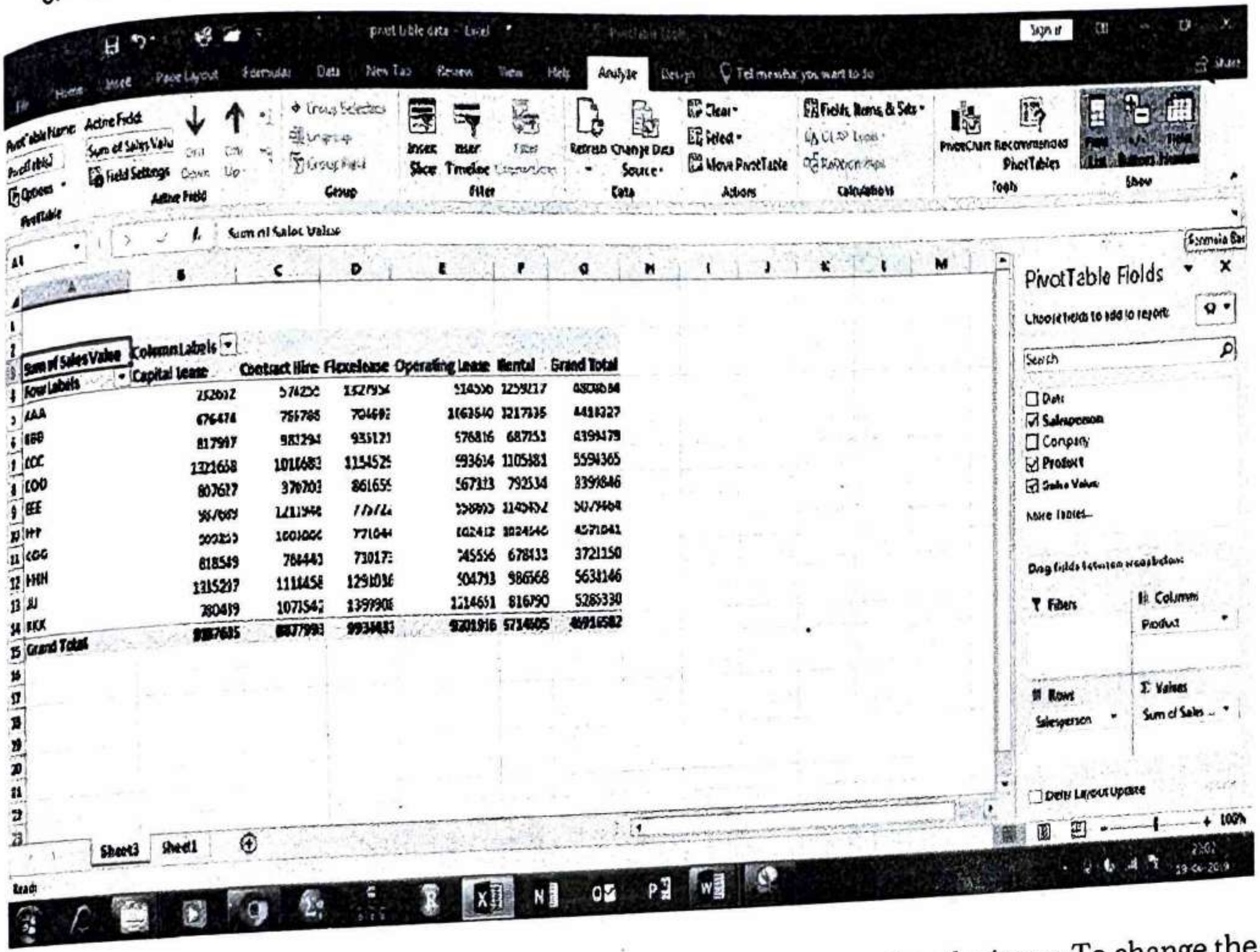
OK
Cancel

4. Pivot table field will appear on the right side of a new worksheet as shown below:


PivotTable Fields
Choose fields to add to report:
Search
☐ Date
☐ Salesperson
☐ Company
☐ Product
☐ Sales Value
More Tables...
Drag fields between areas below:
Filters
Columns
Rows
Values
☐ Defer Layout Update
Update
100%

4. Drag fields: To get the required table,drag the fields to different areas.
5. The required pivot table appears in the worksheet.

6. Change summary calculation:



pivot table data - Excel
File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Analyze
Design
Tell me what you want to do
PivotTable Name:
PivotTable
Options
Active Field:
Sum of Sales Value
Field Settings
Drill Down
Drill Up
Active Field
Group Selection
Ungroup
Group Field
Group
Insert Slicer
Insert Timeline
Filter Connections
Filter
Refresh
Change Data Source
Data
Clear
Select
Move PivotTable
Actions
Fields, Items, & Sets
OLAP Tools
Relationships
Calculations
PivotChart
Recommended PivotTables
Tools
Show
Sheet3
Sheet1
Ready
100%

A1 Sum of Sales Value

Sum of Sales Value	Column Labels					
Row Labels	Capital Lease	Contract Hire	Flexelease	Operating Lease	Rental	Grand Total
AAA	252632	574250	1527954	514550	1259217	[illegible]
BBB	676474	755785	704692	1063540	1217335	4418327
CCC	817997	983294	935121	576816	687153	4399479
DDD	1321658	1016683	1154525	993614	1105481	5594365
EEE	807627	370703	861655	567313	792534	3399846
FFF	[illegible]	1211948	[illegible]	[illegible]	[illegible]	[illegible]
GGG	[illegible]	1001006	771044	[illegible]	1024546	4571041
HHH	818549	784443	730173	345556	678433	3721150
JJJ	1315217	1111458	1291036	504793	986568	5638146
KKK	780419	1071542	1399908	1214651	816790	5265330
Grand Total	[illegible]	[illegible]	[illegible]	9201916	5714605	[illegible]

PivotTable Fields

Choose fields to add to report:

Search

☐ Date
☑ Salesperson
☐ Company
☑ Product
☑ Sales Value

More Tables...

Drag fields between areas below:

Filters

Columns: Product

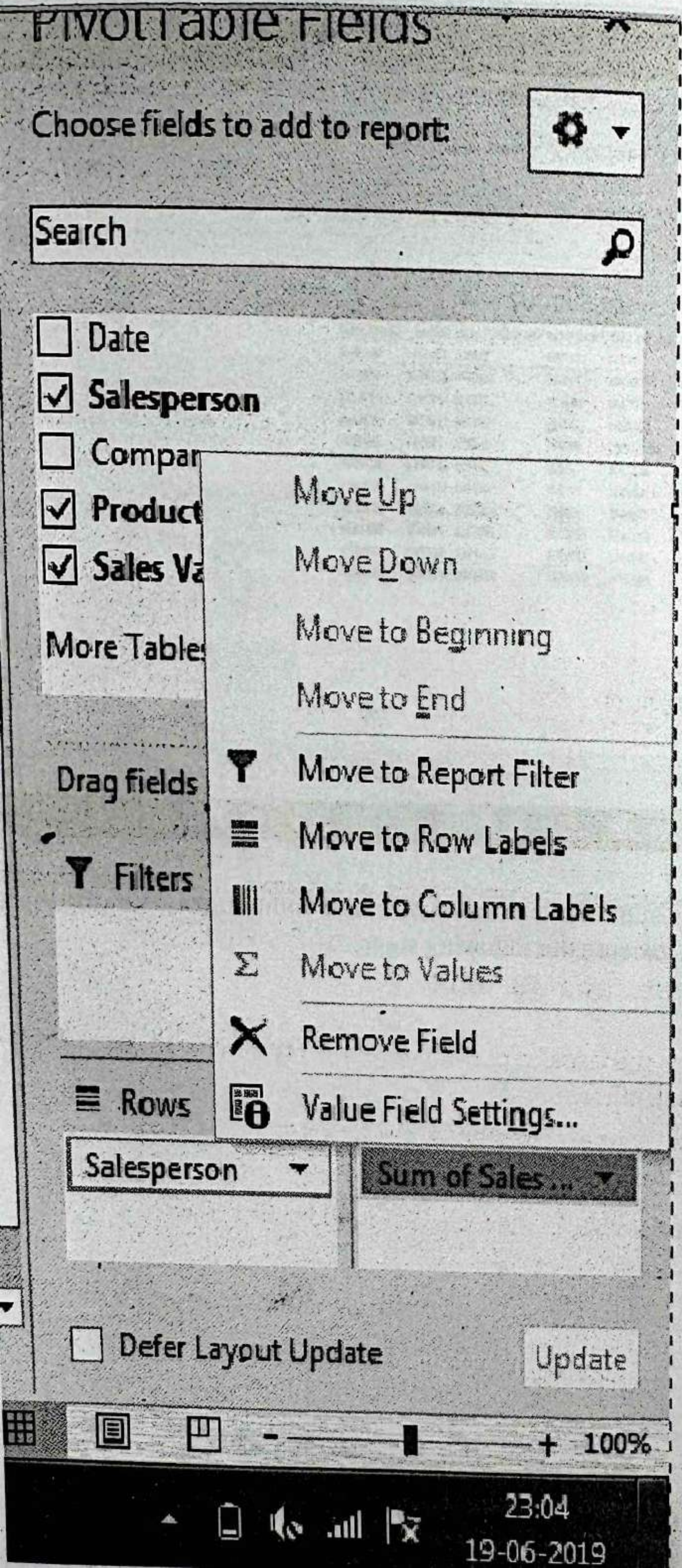
Rows: Salesperson

Values: Sum of Sales...

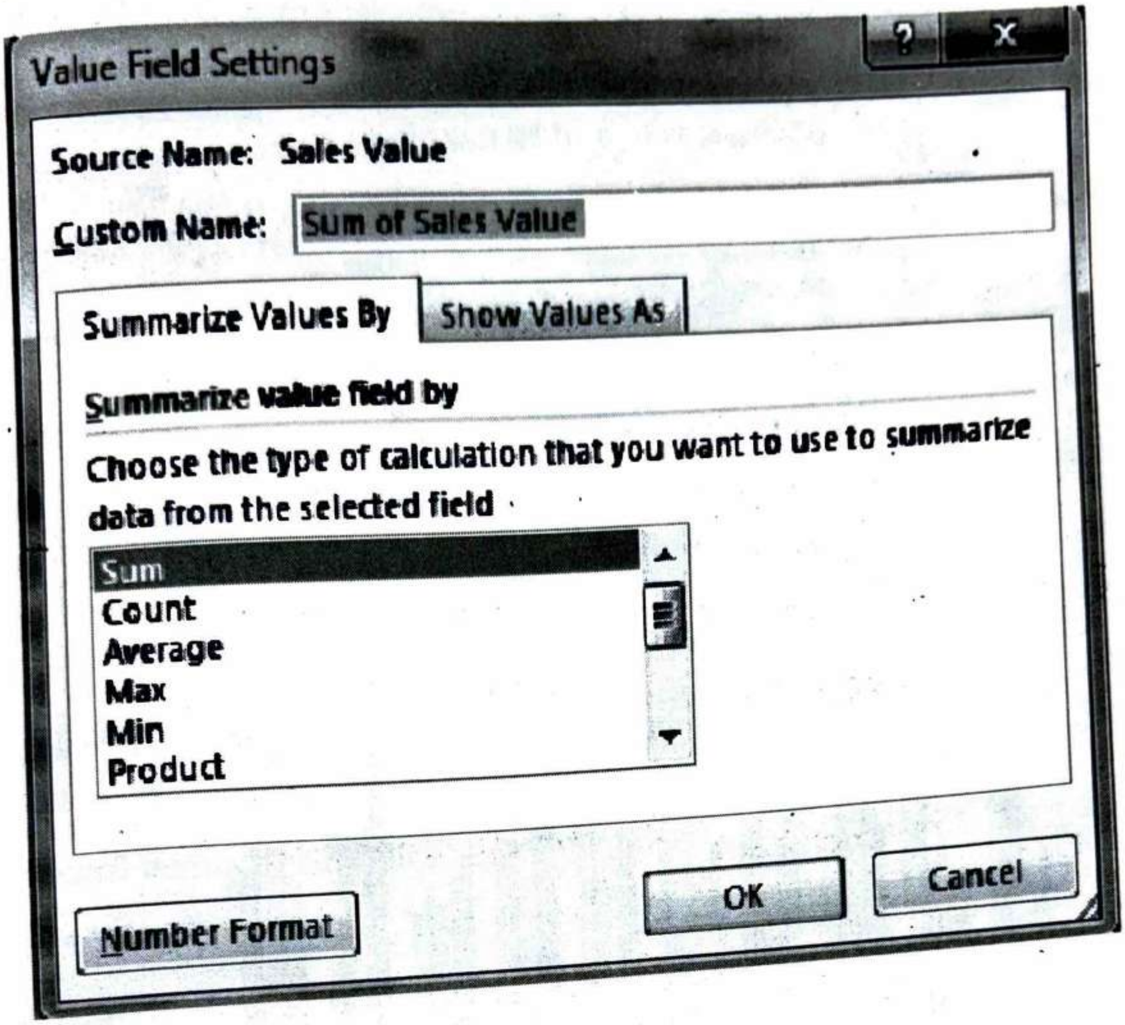
☐ Defer Layout Update

By default,excel summarise the data by either summing or counting the items.To change the type of calculation, exceute the following steps.

n the Values tab and click on value field settings.


PivotTable Fields
Choose fields to add to report:
Search
☐ Date
☑ Salesperson
☐ Compar
☑ Product
☑ Sales Va
More Table
Drag fields
Filters
Rows
Salesperson
Sum of Sales ...
Move Up
Move Down
Move to Beginning
Move to End
Move to Report Filter
Move to Row Labels
Move to Column Labels
Move to Values
Remove Field
Value Field Settings...
☐ Defer Layout Update
Update
100%
23:04
19-06-2019

(b) Value field settings dialog will appear and one can change the type of calculation.



Value Field Settings
?
X

Source Name: Sales Value

Custom Name: Sum of Sales Value

Summarize Values By
Show Values As
Summarize value field by

Choose the type of calculation that you want to use to summarize data from the selected field

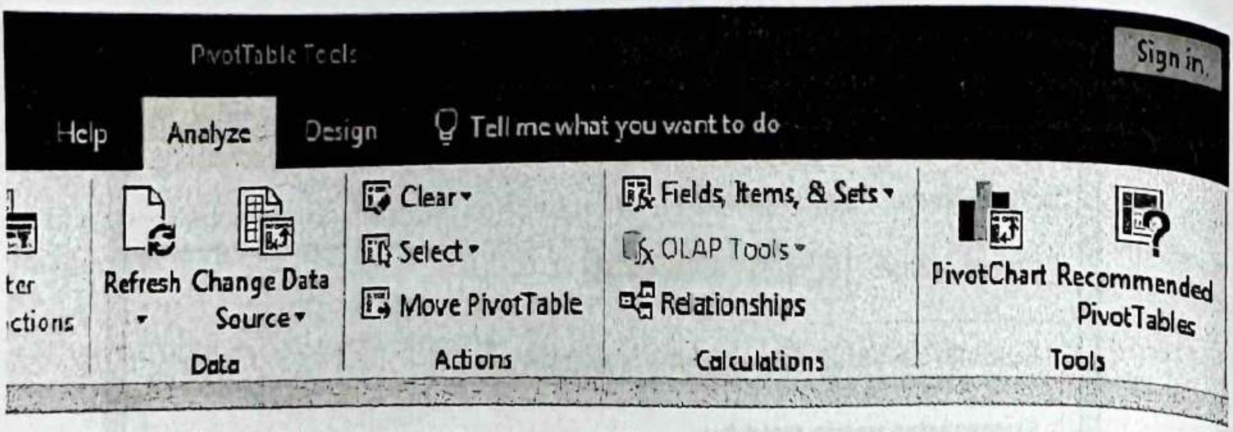
Sum
Count
Average
Max
Min
Product
Number Format
OK
Cancel

8.9.2 Pivot charts and its tools

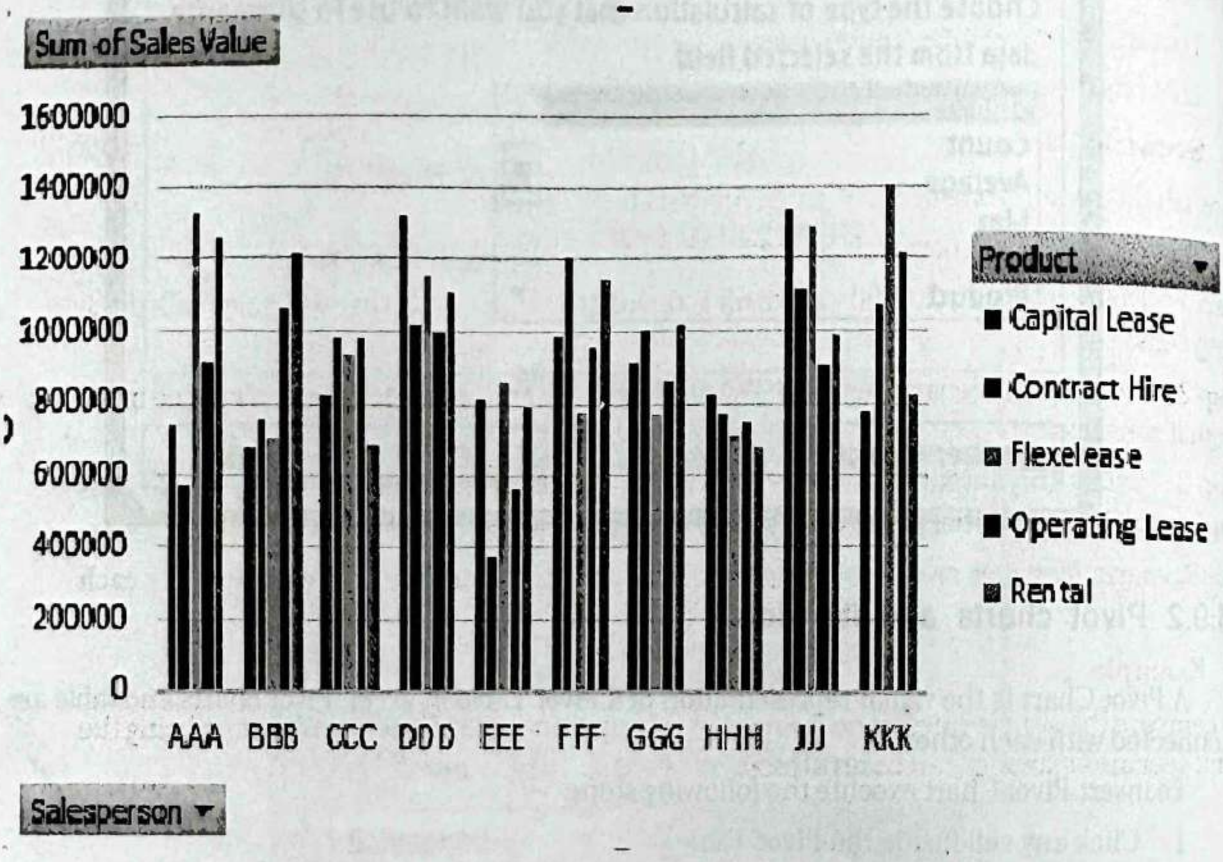
A Pivot Chart is the visual representation of a Pivot Table in excel. Pivot charts and table are connected with each other.

To insert Pivot Chart execute the following steps:

1. Click any cell inside the Pivot Table.
2. On the analyse tab, in the tools group, click pivot charts.


PivotTable Tools
Sign in
Help
Analyze
Design
Tell me what you want to do
ter
ctions
Refresh
Change Data Source
Data
Clear
Select
Move PivotTable
Actions
Fields, Items, & Sets
OLAP Tools
Relationships
Calculations
PivotChart
Recommended PivotTables
Tools

3. Pivot Chart will appear on the screen as shown below :



8.10 MANAGE SCENARIOS AND SUMMARIES

Scenario Manager is useful in the cases where one has more than two variables in sensitivity analysis. Scenario Manager creates scenarios for each set of the input values for the variables under consideration. Scenarios helpto explore a set of possible outcomes, supporting the following :

- Varying as many as 32 input sets.
- Merging the scenarios from several different worksheets or workbooks.

If one wants to analyze more than 32 input sets, and the values represent only one or two variables, Data Tables can be used. Although it is limited to only one or two variables, a Data Table can include as many different input values as required.

✓ What are Scenarios

A scenario is a set of values that Excel saves and can substitute automatically on the worksheet. Different groups of values as scenarios can be created and saved on a worksheet and then switch between these scenarios to view the different results.

For example, one can have several different budget scenarios that compare various possible income levels and expenses. One can also have different loan scenarios from different sources that compare various possible interest rates and loan tenures.

If the information that onewant to use in scenarios is from different sources, the information can be collected in separate workbooks, and then merge the scenarios from the different workbooks into one.

After collecting all the required scenarios a scenario summary report can be created -

- That incorporates information from all the scenarios.
- That lets the comparison of the scenarios side-by-side.

✓ Scenario Manager

Scenario Manager is one of the What-if Analysis tools in Excel.

To create an analysis report with Scenario Manager, following are the steps -

Step 1 - Define the set of initial values and identify the input cells that will vary, called the changing cells.

Step 2 - Create each scenario, name the scenario and enter the value for each changing input cell for that scenario.

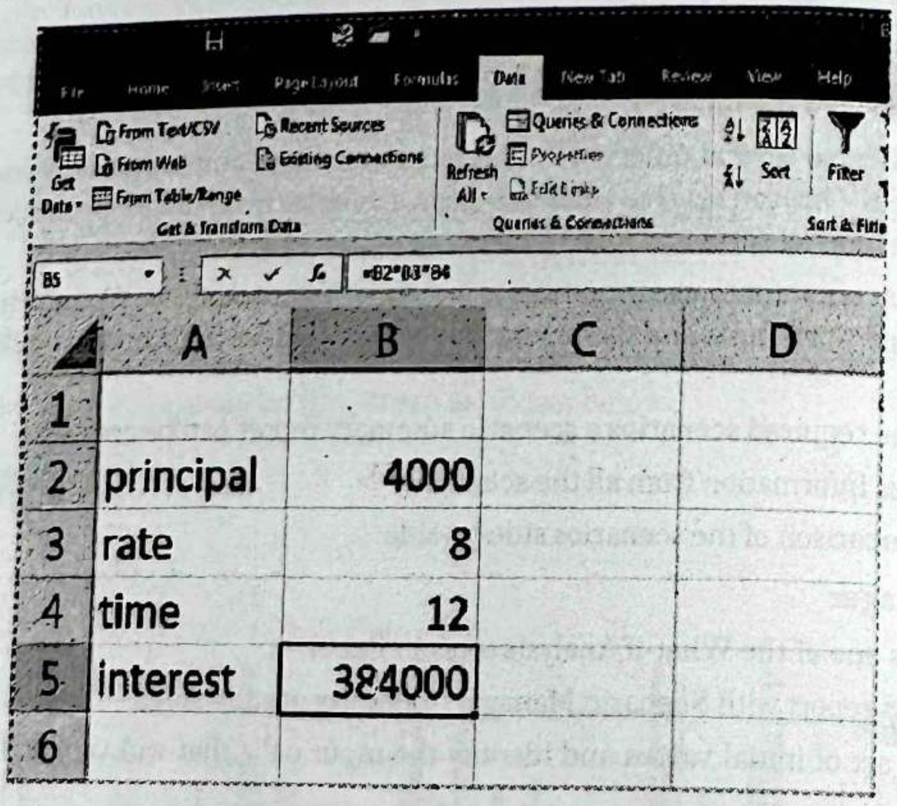
Step 3 - Select the output cells, called the result cells that the user will track. These cells contain formulas in the initial set of values. The formulas use the changing input cells.

The Scenario Manager creates a report containing the input and the output values for each scenario.

✓ Example :

To compare the simple interest on 5 values of principal and rate of interest with time being the constant, scenario manager can be created as:

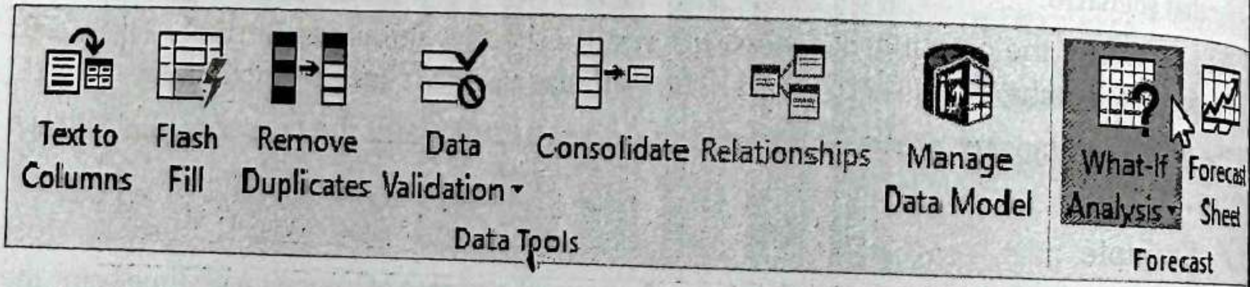
1. Create the data in Excel as shown below


File
Home
Insert
Page Layout
Formulas
Data
New Tab
Review
View
Help
Get Data
From Text/CSV
From Web
From Table/Range
Recent Sources
Existing Connections
Get & Transform Data
Refresh All
Queries & Connections
Properties
Edit Links
Queries & Connections
Sort
Filter
Sort & Filter

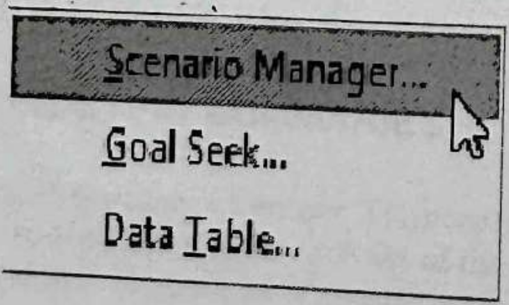
B5 =B2*B3*B4

	A	B	C	D
1				
2	principal	4000		
3	rate	8		
4	time	12		
5	interest	384000		
6				

2. On the Data tab, in the Forecast group, click What-If Analysis.

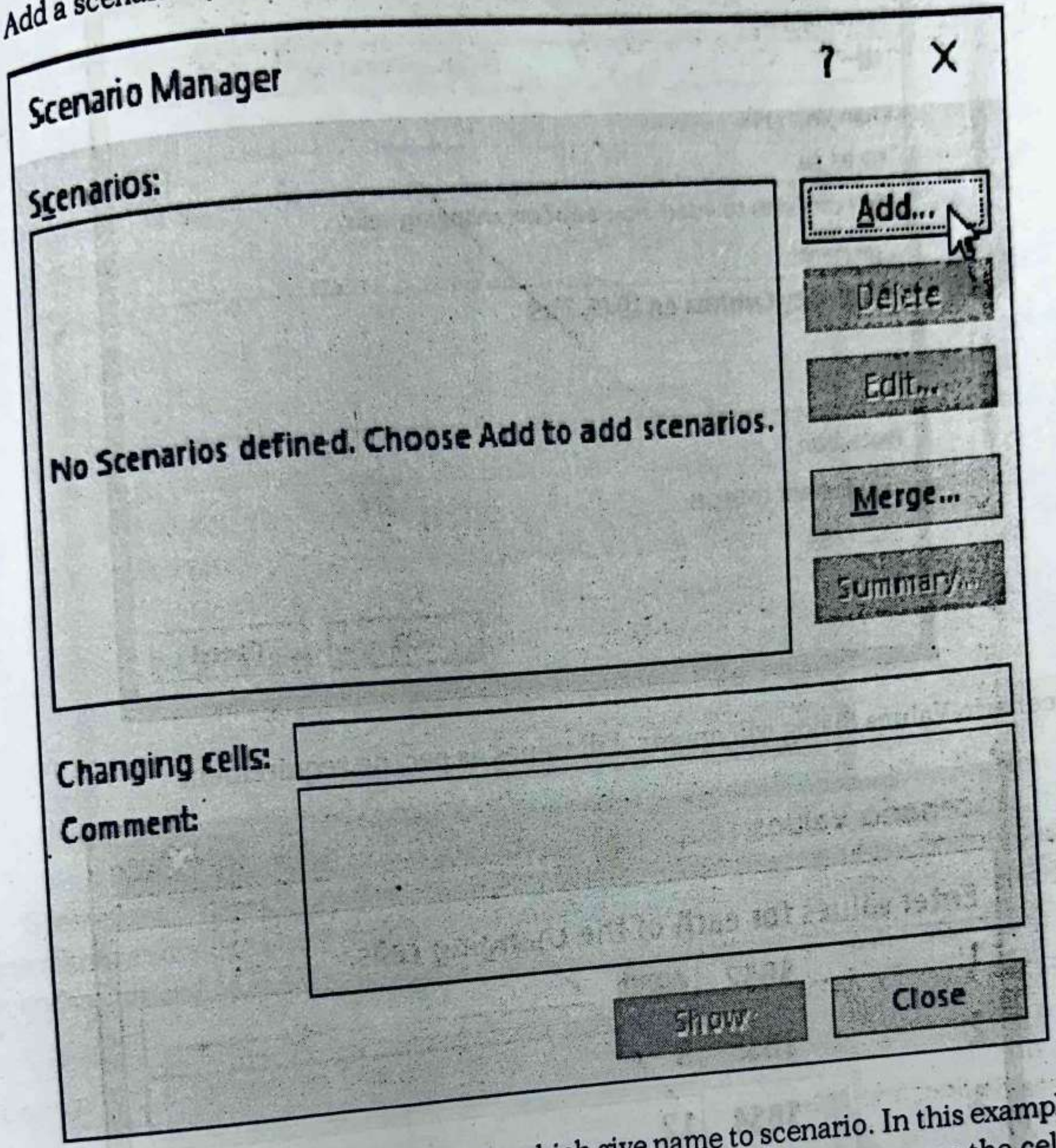

Text to Columns
Flash Fill
Remove Duplicates
Data Validation
Consolidate
Relationships
Manage Data Model
Data Tools
What-If Analysis
Forecast Sheet
Forecast

3. Click Scenario Manager.


Scenario Manager...
Goal Seek...
Data Table...

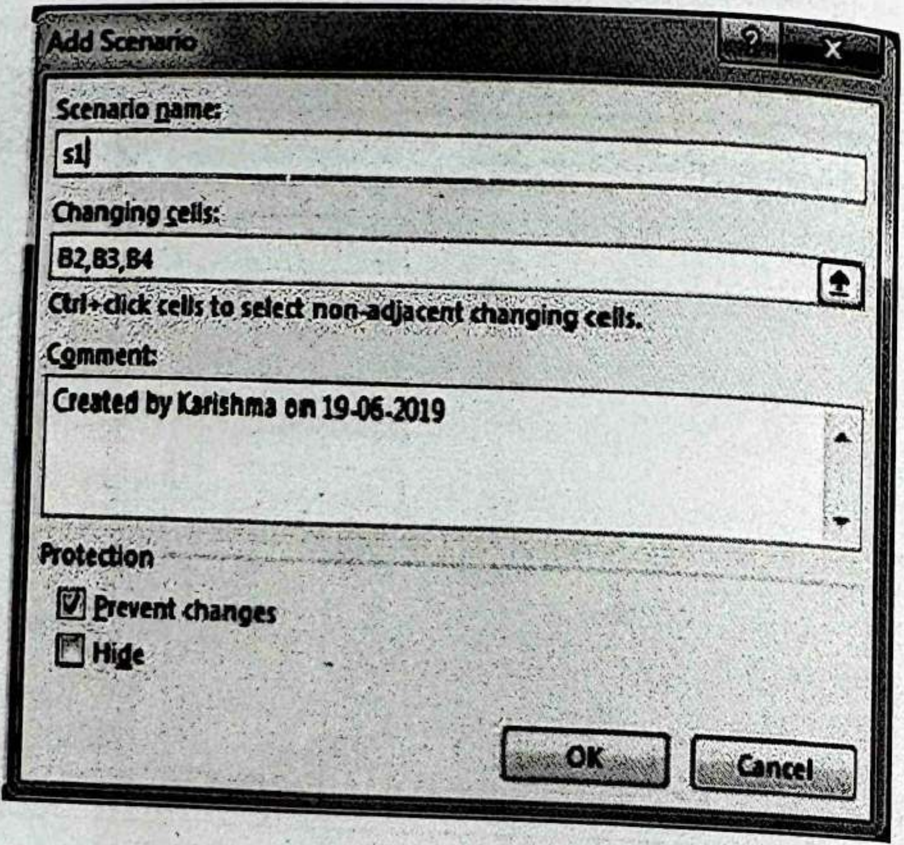
The Scenario Manager dialog box appears.

4. Add a scenario by clicking on Add.


Scenario Manager
?
X
Scenarios:
Add...
Delete
Edit...
Merge...
Summary...
Changing cells:
Comment:
Show
Close

No Scenarios defined. Choose Add to add scenarios.

5. Add Scenario dialog will appear, in which give name to scenario. In this example, s1 name is given to first scenario, which changing cells as B2, B3 and B4 as these are the cells in which principal, rate and time are added; and then click OK


Add Scenario

Scenario name:
s1

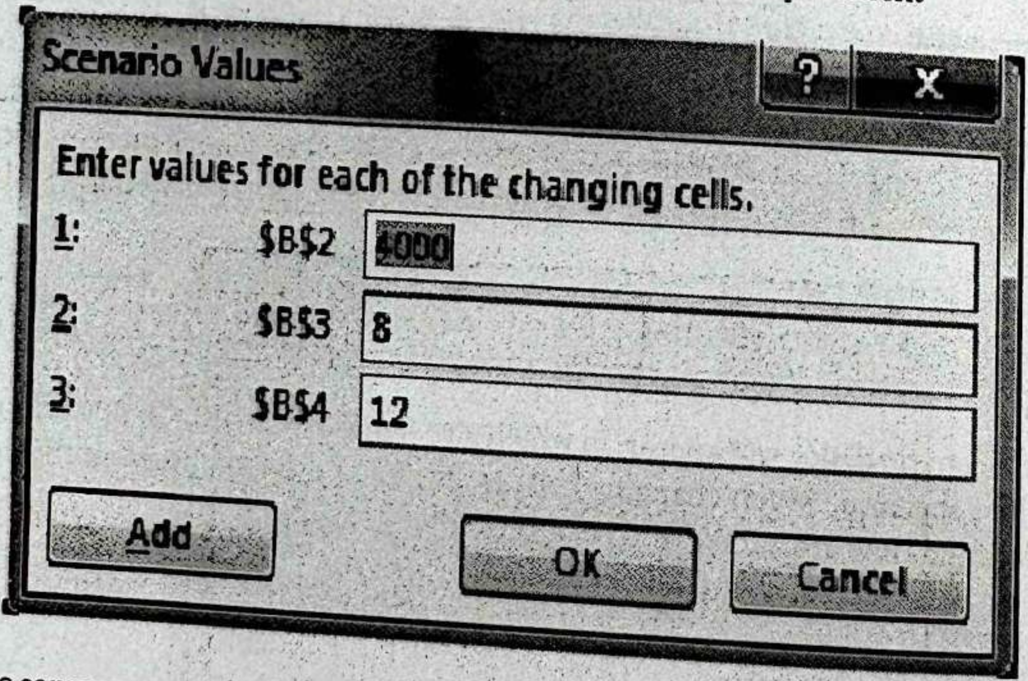
Changing cells:
B2,B3,B4

Ctrl+click cells to select non-adjacent changing cells.

Comment:
Created by Karishma on 19-06-2019

Protection
☑ Prevent changes
☐ Hide

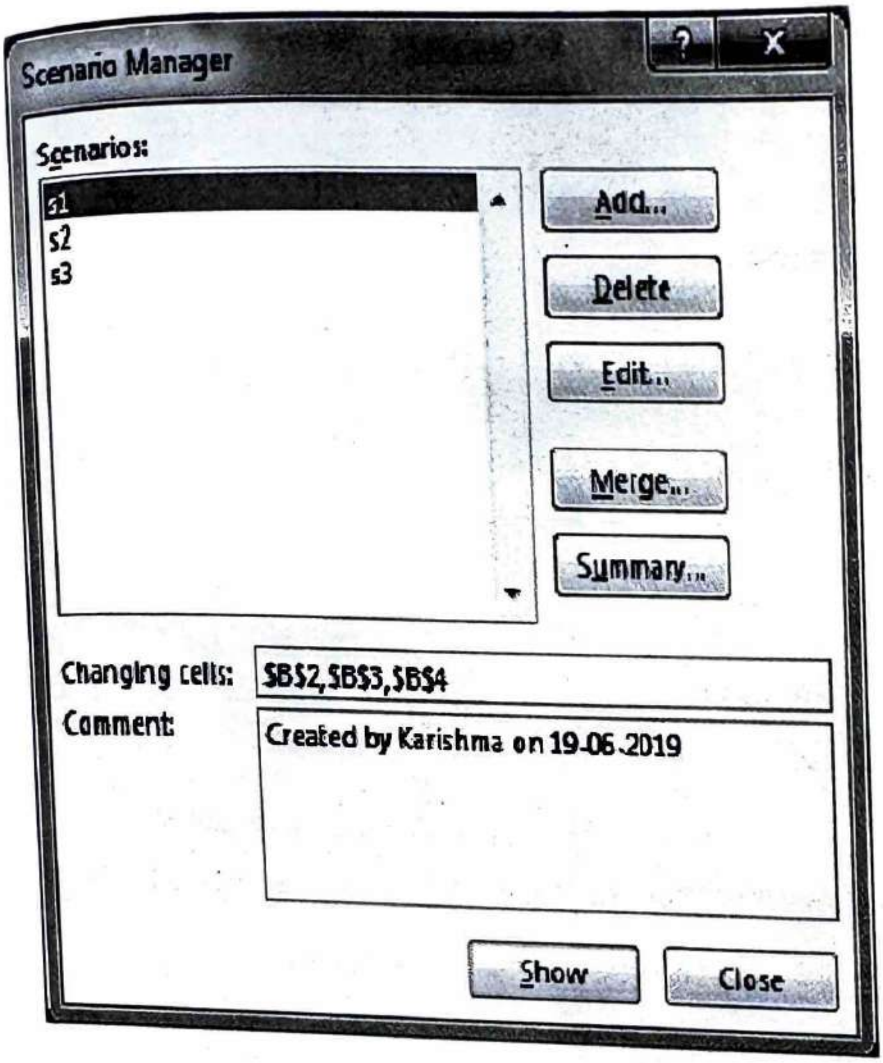
6. Scenario Values dialog will appear. Fill values as per the requirement


Scenario Values

Enter values for each of the changing cells.

1: $B$2 4000
2: $B$3 8
3: $B$4 12

7. In the same way, create scenario s2 and s3. The scenarios created will be shown in the left tab of scenario manager dialog



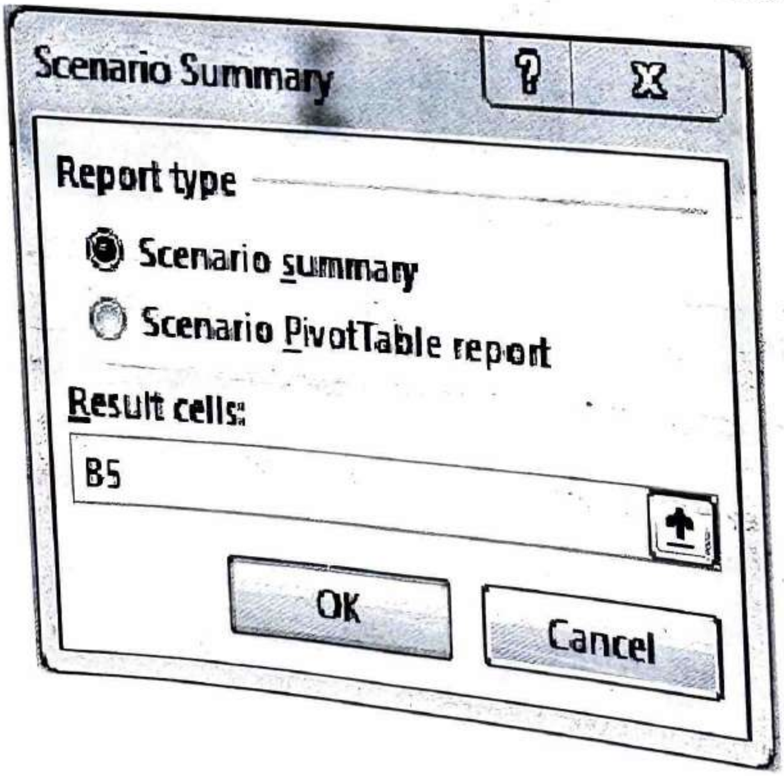
Scenario Manager
?
X
Add...
Delete
Edit...
Merge...
Summary...
Show
Close

Scenarios:
s1
s2
s3

Changing cells: $B$2,$B$3,$B$4

Comment: Created by Karishma on 19-06-2019

8. Scenario summary can be created by clicking on the summary tab on the right side of scenario manager dialog. The scenario summary dialog will appear. Check on scenario summary button and result cell as B 5 because in the example the interest is calculated in cell B5

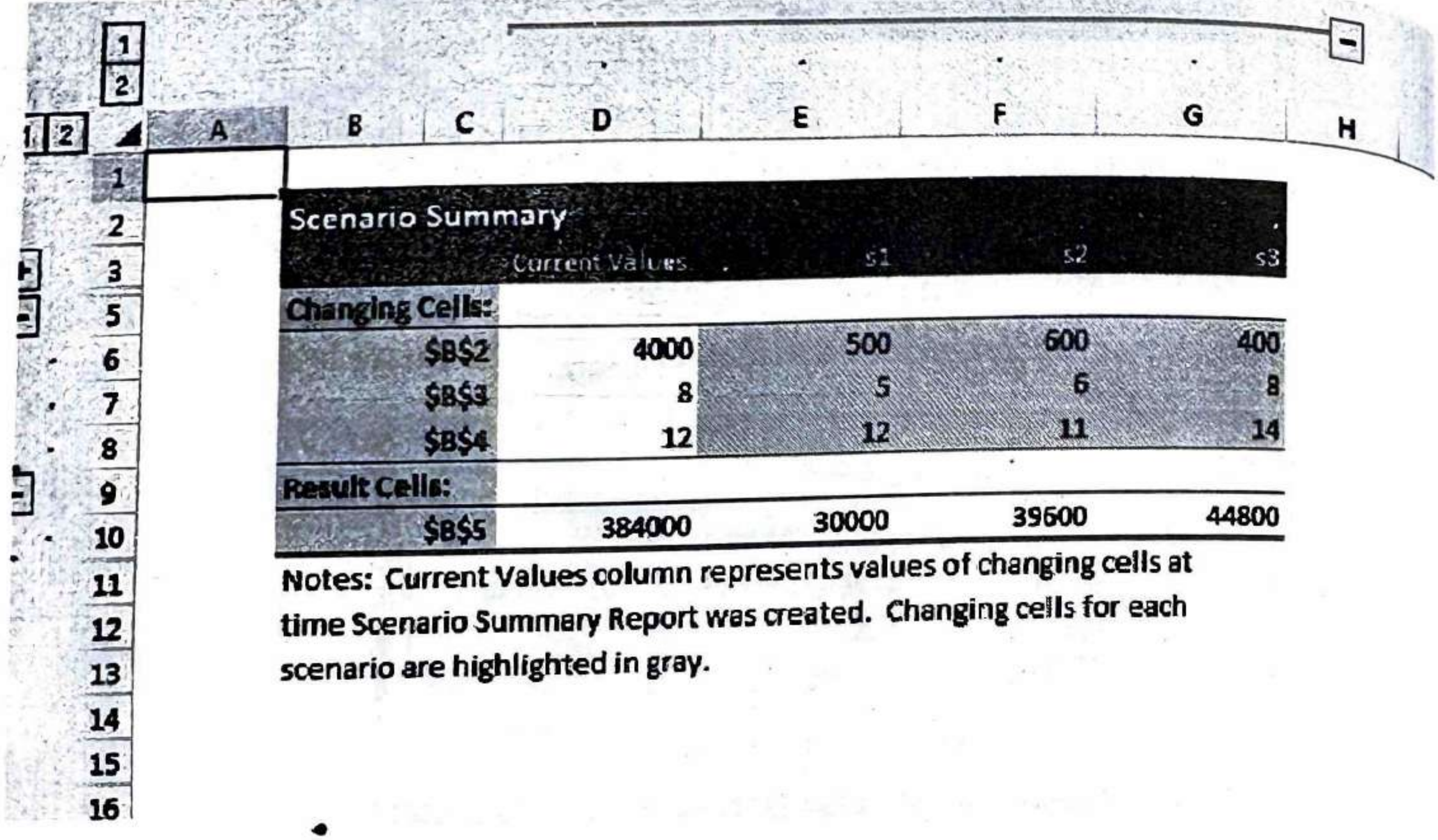


Scenario Summary
?
X
OK
Cancel

Report type
● Scenario summary
○ Scenario PivotTable report

Result cells: B5

9. The output will be scenario summary worksheet in which all the resulting values are calculated that will be used for comparison.



Scenario Summary

	Current Values	s1	s2	s3
Changing Cells:				
$B$2	4000	500	600	400
$B$3	8	5	6	8
$B$4	12	12	11	14
Result Cells:				
$B$5	384000	30000	39600	44800

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

CHAPTER 9

Computer Network

LEARNING OUTCOMES

- ☐ Introduction to Data Communication
- ☐ Data transmission media
- ☐ Network topologies
- ☐ Types of Computer Network
- ☐ Internet, Intranet, Extranet
- ☐ Networking Devices
- ☐ OSI Model

9.0 DATA COMMUNICATION

When we communicate, we are sharing information. This sharing can be local or remote. Between individuals, local communication usually occurs face to face, while remote communication takes place over distance. The term Telecommunication, which includes Telephony, Telegraphy, and television, means communication at a distance.

The data refers to facts, concepts and instruction presented in whatever form is agreed upon by the parties creating and using the data. In the context of computer information system, data represented by binary information units produced and consumed in the form of 0s and 1s.

Data Communications is the transfer of data or information between a source and a receiver. The source transmits the data and the receiver receives it. The actual generation of the information is not part of Data Communications nor is the resulting action of the information at the receiver. Data Communication is interested in the transfer of data, the method of transfer and the preservation of the data during the transfer process.

The purpose of Data Communications is to provide the rules and regulations that allow computers with different disk operating systems, languages, cabling and locations to share resources. The rules and regulations are called protocols and standards in Data Communications.

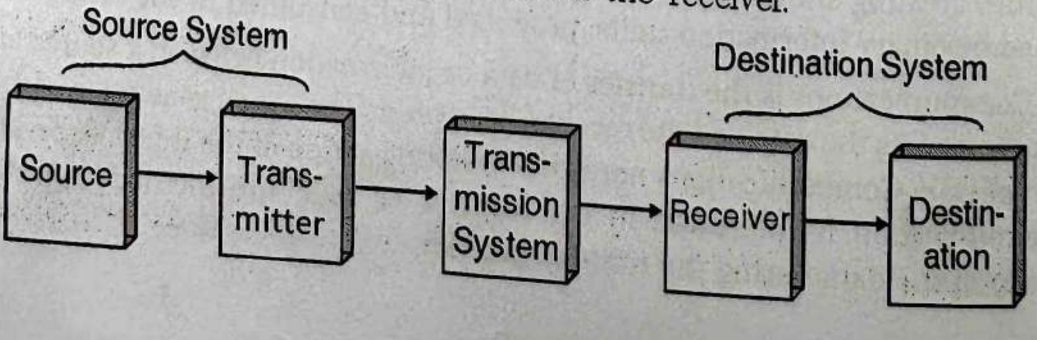
For data communication to occur, the communicating devices must be part of a communication system made up of a combination of hardware and software. The effectiveness of a data communication system depends on the three fundamental characteristics:

1. **Delivery** : The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.
2. **Accuracy** : The system must deliver data accurately. Data that have been altered in transmission and left uncorrected are rustles.
3. **Timeliness** : The system must deliver data in a timely manner. Data delivered late are useless. In the case of video, audio, and voice data, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. this kind of delivery id called real-time transmission.

9.0.1 Data Communication model

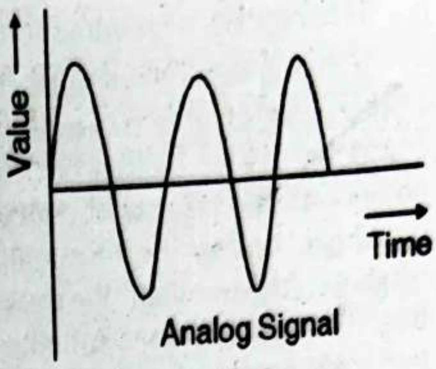
The fundamental purpose of a communications system is the exchange of data between two parties. For example, the communication between a workstation and a server over a public telephone network, or the exchange of voice signals between two telephones over the same network. The key elements of the model are as follows:

- **Source** : This device generates the data to be transmitted; examples are tele-phones and personal computers.
- **Transmitter** : Usually, the data generated by a source system are not trans-mitted directly in the form in which they were generated. Rather, a transmitter transforms and encodes the information in such a way as to produce electromagnetic signals that can be transmitted across some sort of transmission system. For example, a modem takes a digital bit stream from an attached device such as a personal computer and transforms that bit stream into an analog signal that can be handled by the telephone network.
- **Transmission system** : This can be a single transmission line or a complex network connecting source and destination.
- **Receiver** :The receiver accepts the signal from the transmission system and converts it into a form that can be handled by the destination device. For example, a modem will accept an analog signal coming from a network or transmission line and convert it into a digital bit stream.
- **Destination** : Takes the incoming data from the receiver.



9.0.2 Analog and Digital Transmission media

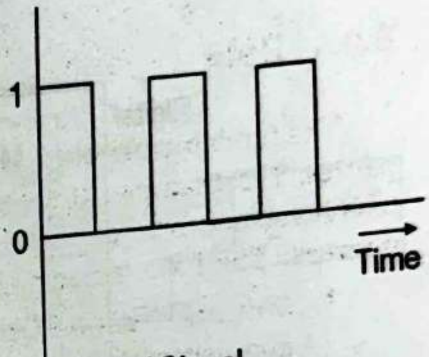
Analog signal is a kind of continuous wave form that changes over time. An anlaog signal is further classified into simple and composite signals. A simple analog signal is a sine wave that cannot be decomposed further. On the other hand, a composite analog signal can be further decomposed into multiple sine waves. An analog signal is described using amplitude, period or frequency and phase. Amplitude marks the maximum height of the signal. Frequency marks the rate at which signal is changing. Phase marks the position of the wave with respect to time zero.



Analog Signal

An analog signal is not immune to noise hence, it faces distortion and decrease the quality of transmission. The range of value in an analog signal is not fixed.

Digital signals also carry information like analog signals but is somewhat is different from analog signals. Digital signal is noncontinuous, discrete time signal. Digital signal carries information or data in the binary form i.e. a digital signal represent information in the form of bits. Digital signal can be further decomposed into simple sine waves that are called harmonics. Each simple wave has different amplitude, frequency and phase. Digital signal is described with bit rate and bit interval. Bit interval describes the time require for sending a single bit. On the other hand, bit rate describes the frequency of bit interval.



Digital Signal

A digital signal is more immune to the noise; hence, it hardly faces any distortion. Digital signals are easier to transmit and are more reliable when compared to analog signals. Digital signal has a finite range of values. The digital signal consists 0s and 1s.

9.0.3 Modulation and Demodulation

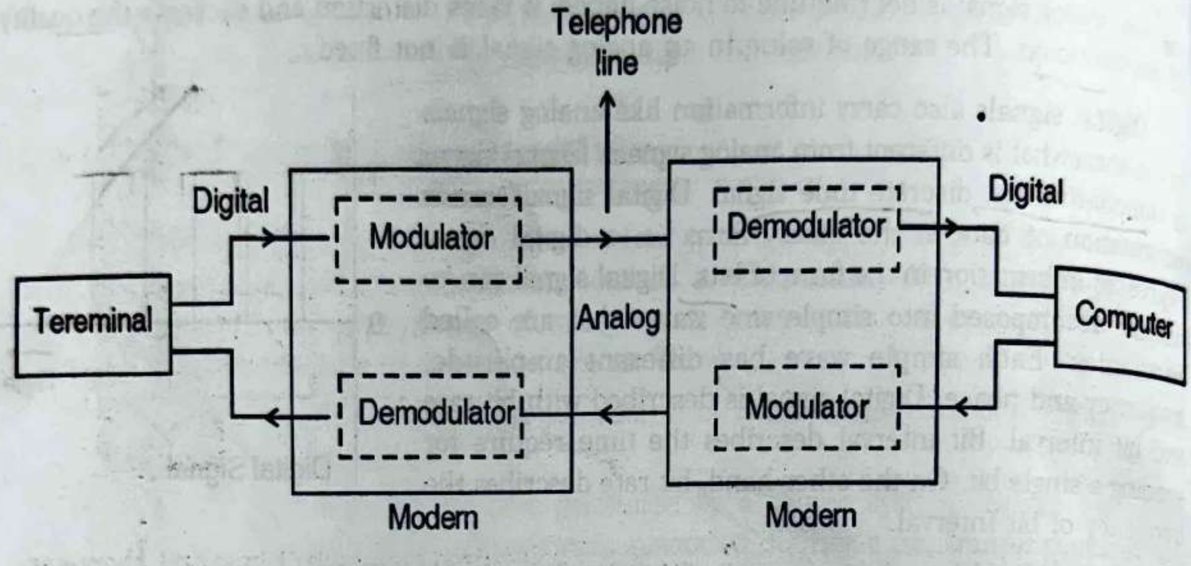
A message carrying signal has to get transmitted over a distance and for it to establish a reliable communication, it needs to take the help of a high frequency signal which should not affect the original characteristics of the message signal.

The characteristics of the message signal, if changed, the message contained in it also alters. Hence it is a must to take care of the message signal. A high frequency signal can travel up to a longer distance, without getting affected by external disturbances. We take the help of such high frequency signal which is called as a carrier signal to transmit our message signal. Such a process is simply called as Modulation.

Demodulation is defined as extracting the original information carrying signal from a modulated carrier wave. A demodulator is an electronic circuit that is mainly used to recover the information content from the modulated carrier wave. There are different types of modulation and so are demodulators. The output signal via demodulator may describe the sound, images or binary data.

The process of modulation and demodulation is explained below :

If digital signals are to be transmitted from a terminal to a computer, they are converted to analog signals before transmission. This is done by modulator. The analog signals received by the computer are converted back to digital form by a demodulator to permit processing by the computer. The processed digital information is modulated to analog form and returned via the telephone line to the terminal where the analog signals are demodulated to digital form for display on the terminal. We thus need a modulator-demodulator pair at both ends of the telephone line. This equipment is called a modem. Figure below illustrates the use of modems. There are two main reasons for using modems – (a) They allow higher speeds of transmission on a given analog line, and (b) they reduce the effects of noise and distortion.



9.0.4 Methods of Transmission- Synchronous and Asynchronous

In synchronous transmission, data moves in a complete paired approach in the form of chunks or frames. Synchronisation between the source and target is required so that the source knows where the new byte begins since there is no space between the data.

Synchronous transmission is effective, dependable and is utilised for transmitting a large amount of data. It offers real-time communication between linked devices.

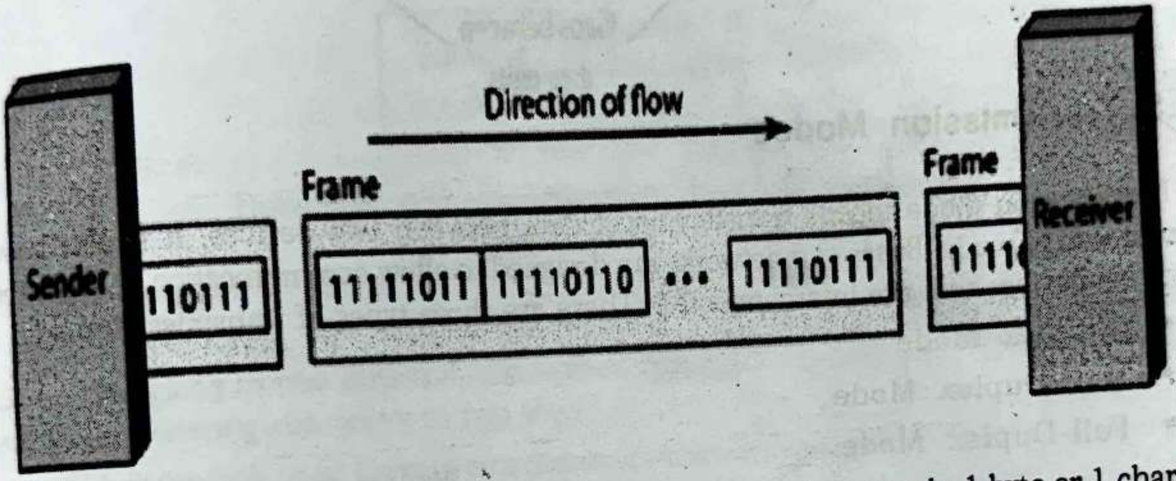
A comparison of synchronous transmission would be the transfer of a large text file. Before the file is transmitted, it is first dissected into blocks of sentences. The blocks are then transferred over the communication link to the target location.Because there is no beginning and end bits the data transfer rate is quicker but there's a possibility of more errors to occur. Over time, clocks will get out of sync and the target device would have the incorrect time, so some bytes could become tampered due to lost bits. To resolve this issue, there is a need for regular re-synchronisation of the clocks as well as the use of check digits to make sure that the bytes are correctly received and translated.

✓ Characteristics of Synchronous Transmission

  - There are no spaces in between characters being sent.
  - Timing is provided by modems or other devices at the end of the transmission.
  - Special syn characters goes before the data being sent.
  - The syn characters are applied between chunks of data for timing functions.

✓ Examples of Synchronous Transmission

  - Chatrooms
  - Video conferencing
  - Telephonic conversations
  - Face-to-face interactions



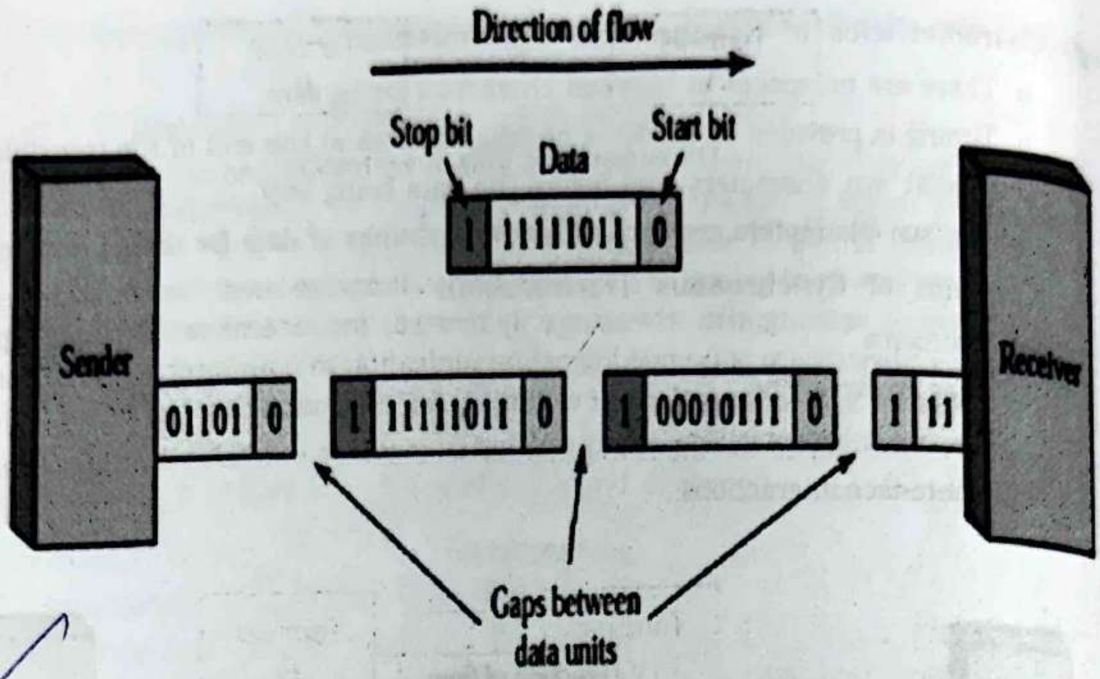
In asynchronous transmission data moves in a half-paired approach, 1 byte or 1 character at a time. It sends the data in a constant current of bytes. The size of a character transmitted is 8 bits where a parity bit is added each at the beginning and at the end which makes it a total of 10 bits. It doesn't need a clock for integration; rather it utilises the parity bits to inform the receiver how to translate the data.It is straightforward, quick, cost-effective and doesn't need a 2-way communication.

✓ Characteristics of Asynchronous Transmission

  - Each character is headed by a beginning bit and superseded by one or more end bits.
  - There may be gaps or spaces in between characters.

✓ Examples of Asynchronous Transmission

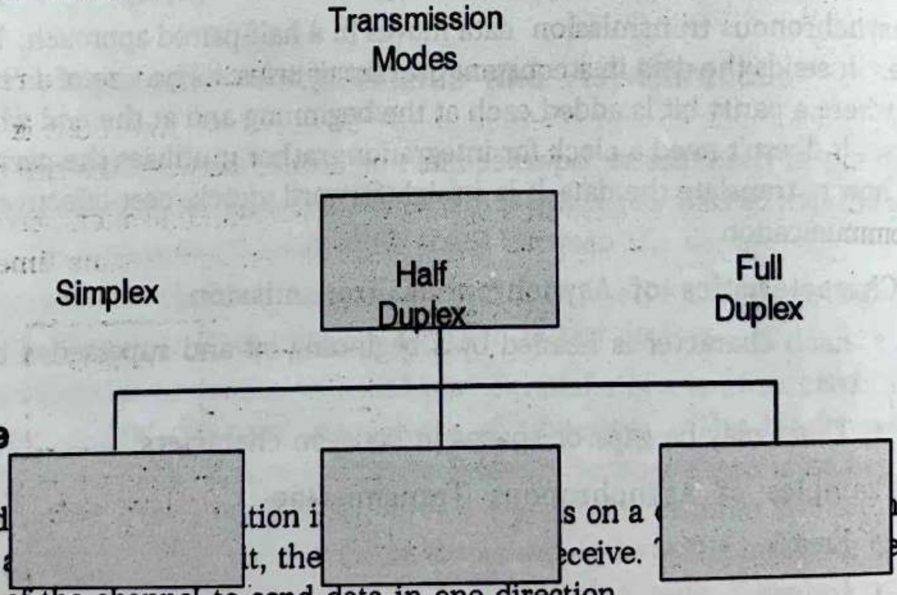
  - Emails
  - Forums
  - Radios
  - Televisions


Direction of flow
Stop bit
Data
Start bit
1 11111011 0
Sender
01101 0
1 11111011 0
1 00010111 0
1 11
Receiver
Gaps between data units

9.0.5 Transmission Modes

Transmission mode means transferring of data between two devices. It is also known as communication mode. Buses and networks are designed to allow communication to occur between individual devices that are interconnected. There are three types of transmission mode:-

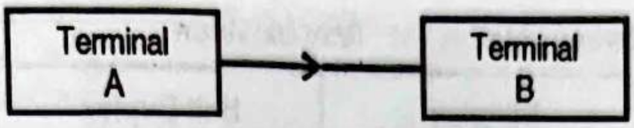
- **Simplex Mode**
- **Half-Duplex Mode**
- **Full-Duplex Mode**


Transmission Modes
Simplex
Half Duplex
Full Duplex

✓ Simplex Mode

In Simplex mod [illegible] tion i [illegible] s on a [illegible] ly one of the two devices on [illegible] t, the [illegible] ceive. [illegible] can use the entire capacity of the channel to send data in one direction.

Example : Keyboard and traditional monitors. The keyboard can only introduce input, the monitor can only give the output.

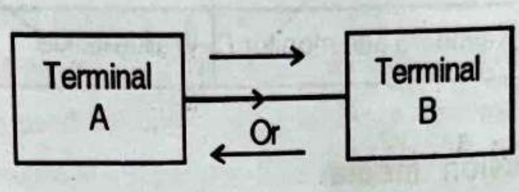


Transmission in only one direction

✓ Half-Duplex Mode

In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa. The half-duplex mode is used in cases where there is no need for communication in both direction at the same time. The entire capacity of the channel can be utilized for each direction.

Example: Walkie- talkie in which message is sent one at a time and messages are sent in both the directions.



Transmission in either direction, but not simultaneously

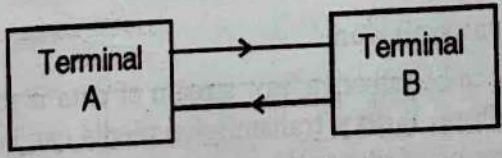
✓ Full-Duplex Mode

In full-duplex mode, both stations can transmit and receive simultaneously. In full duplex mode, signals going in one direction share the capacity of the link with signals going in other direction, this sharing can occur in two ways:

- o Either the link must contain two physically separate transmission paths, one for sending and other for receiving.
- o Or the capacity is divided between signals travelling in both directions.

Full-duplex mode is used when communication in both directions is required all the time. The capacity of the channel, however must be divided between the two directions.

Example : Telephone Network in which there is communication between two persons by a telephone line, through which both can talk and listen at the same time.



Transmission in both directions simultaneously

✓ **Difference between Modes of Transmission**

Basis for Comparison	Simplex	Half Duplex	Full Duplex
Direction of Communication	Unidirectional	Two-directional, one at a time	Two-directional, simultaneously
Send / Receive	Sender can only send data.	Sender can send and receive data, but one a time.	Sender can send and receive data simultaneously.
Performance	Least performing mode of transmission.	Better than Simplex	Most performing mode of transmission.
Example	Keyboard and monitor	Walkie-talkie	Telephone

9.0.6 Data transmission media

These can be classified according to their Bandwidth (data transmission speed) and Medium of transmission

(A) Bandwidth (data transmission speed)

- o Narrow - Band channels – The common definition of narrowband is when 25 kHz or less is used for the radio channel. So, a narrow band channel transmits data at a very slower rate (40-100 bits per second). The benefit of using a narrow channel is the lower noise bandwidth and hence better sensitivity and range. Example - Telegraph Line
- o Voice - Band channels – These are the channels that transmit data at rates between 110 and 9600 bits per second. Example: Telephone lines.
- o Broad - Band channels – These are the channels that transmit data at fastest rate, i.e. several megabits per second. Example – microwaves, coaxial cables and fibre optics.

(B) Medium of transmission

For any networking to be effective, raw stream of data is to be transported from one device to other over some medium. Various transmission media can be used for transfer of data. These transmission media may be of two types :

- o Guided : Guided media use a physical connection between two devices. The waves are guided along a physical path over the medium. A signal has to travel within the physical limits of the guided medium through cabling system that has a fixed path. For example, Twisted pair cable, coaxial cable and fibre optic wires.
- o Unguided : In unguided media, transmitted data travels through free space in form of electromagnetic signal. For example, radio waves, lasers, etc.

Each transmission media has its own advantages and disadvantages in terms of bandwidth, speed, delay, cost per bit, ease of installation and maintenance, etc. Let's discuss some of the most commonly used media in detail.

- **Twisted Pair Cable :** Twisted pair cable is a cable which is made by intertwining two separate insulated wires together. A twisted pair cable consists of two conductors, which are normally made of copper. This pair has a bandwidth to distance ratio of about 1 MHz per kilometer. These are of two types: shielded and un-shielded. Shielded Twisted Pair (STP) has a fine wire mesh surrounding the wires which helps to protect the transmission Unshielded Twisted Pair (UTP) does not have that mesh. Shielded cable is used in older telephone networks, network, and data communications to reduce outside interference.

  ✓ **Advantages of twisted pair cable**

  Twisted pair cable are the oldest and most popular cables all over the world. This is due to the many advantages that they offer

  - Trained personnel easily available due to shallow learning curve
  - Can be used for both analog and digital transmissions
  - Least expensive for short distances
  - Entire network does not go down if a part of network is damaged

  ✓ **Disadvantages of twisted pair cable**

  With its many advantages, twisted pair cables offer some disadvantages too

  - Signal cannot travel long distances without repeaters
  - High error rate for distances greater than 100m
  - Very thin and hence breaks easily
  - Not suitable for broadband connections

  ✓ **Shielding twisted pair cable**

  To counter the tendency of twisted pair cables to pick up noise signals, wires are shielded in the following three ways "

  - Each twisted pair is shielded.
  - Set of multiple twisted pairs in the cable is shielded.
  - Each twisted pair and then all the pairs are shielded.

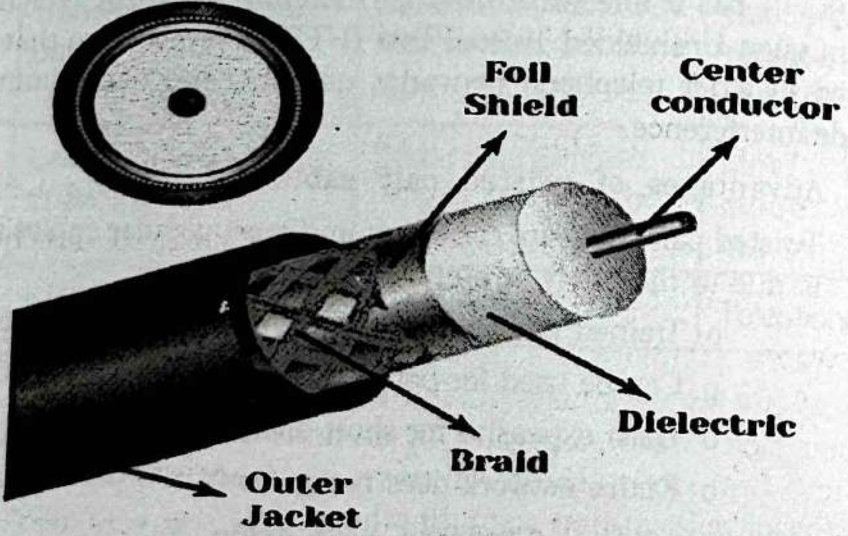
  Such twisted pairs are called shielded twisted pair (STP) cables. The wires that are not shielded but simply bundled together in a protective sheath are called unshielded twisted pair (UTP) cables. These cables can have maximum length of 100 metres.

  Shielding makes the cable bulky, so UTP are more popular than STP. UTP cables are used as the last mile network connection in homes and offices.

- **Coaxial Cable :** Coaxial cables are copper cables with better shielding than twisted pair cables, so that transmitted signals may travel longer distances at higher speeds. A coaxial cable consists of these layers, starting from the innermost.

- Stiff copper wire as core
- Insulating material surrounding the core
- Closely woven braided mesh of conducting material surrounding the insulator
- Protective plastic sheath encasing the wire

Coaxial cables are widely used for cable TV connections and LANs.



✓ Advantages of Coaxial Cables

These are the advantages of coaxial cables "

- Excellent noise immunity
- Signals can travel longer distances at higher speeds, e.g. 1 to 2 Gbps for 1 Km cable
- Can be used for both analog and digital signals
- Inexpensive as compared to fibre optic cables
- Easy to install and maintain

✓ Disadvantages of Coaxial Cables

These are some of the disadvantages of coaxial cables "

- Expensive as compared to twisted pair cables
- Not compatible with twisted pair cables

➢ **Optical Fiber** : Optical fiber cable is a cable made of optical fibers that can transmit large amounts of information at the speed of light. It is a medium and the technology associated with the transmission of information as light pulses along a glass or plastic strand. Optical fiber carries much more information than conventional copper wire. In one cable, there are many optical fibers. The glass fiber requires more protection within an outer cable than copper. Basically, it consists of two concentric cylinders: an inner core and a cladding used to surround the core. These are made of transparent plastic or glass material. The density of the core and cladding must be such to be helpful to reflect the beam of light.

The core guides the beam and cladding prevents it. The signal is usually generated by a laser or Light Emitting Diode (LED). The speed of data transfer is really high. Due to high speed and little disturbance these are being used rapidly in telecommunications.

✓ **Advantages of Optical Fiber**

- Higher Bandwidth helps data at a higher rate.
- Less signal attenuation.
- Immunity to electromagnetic interface.
- Light weight.

✓ **Limitations of Optical Fiber**

- It needs experts to install it and provide maintenance.
- Being unidirectional needs two fibers for bi-directional communication.
- Cost factor is high.

➢ **Radio Waves** : Radio waves are an invisible form of electromagnetic radiation, and it is one of the widest ranges in the electromagnetic spectrum. A radio wave is an electromagnetic wave propagated by an antenna. The frequency ranges from 3 Kilo-Hertz to 1 Giga-Hertz. These can travel in any direction and easy to produce waves. It eliminates the cost of physical medium and is very useful for long distanced communication. These are of a very long wavelength, such as thousands of meters, tend to travel along the surface of the earth and even penetrate into the water. These are useful for communication with submarines and for broadcasting time signals, radio broadcast, cellular telephones, etc. Each communication service uses a part of the spectrum that is suitable for its needs. These days cellular radios are used to provide mobile phone networks. These operate in the VHF (Very High Frequency) band. These help in multi casting, which means it transmit a signal for specific group which may be more than one. These are also used in FM radios, cordless phones, etc. A communication between single source and destination is known as unicast and if there are many receivers to catch the signals sent by sender at any destination, it is called broadcast.

➢ **Bluetooth** : Bluetooth is used to send and receive data over short distance in mobile and related technology. A Bluetooth connection is wireless and automatic, and it has a number of interesting features that can simplify our daily lives.

➢ **Microwaves** : Microwaves are radio frequencies, which ranges between about 1 GHz (one gigahertz) to about 300 GHz. It may be defined as a short electromagnetic wave (longer than infrared but shorter than radio waves) used for radar and ovens and for transmitting telephone, facsimile video and data. These are unidirectional waves and hence have less interference by a pair of aligned antenna to another. Uses of Microwave are radio transmission, telecommunication carriers and TV stations.

Satellite is another form of microwave system. Repeaters present in the sky supplement it. Satellites have a high bandwidth and can support variety of channels. It has some limitations such as:

- o High set up cost.
- o The lifetime is limited.
- o These waves cannot be received inside the building.

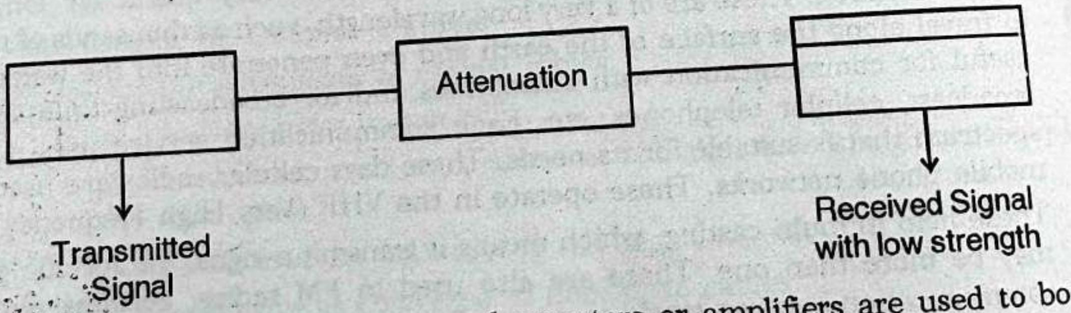
9.0.7 Transmission Impairments

When a signal is being transmitted, it is quite possible that signal gets subjected to a number of impairments. Most important of these impairments are

a. Attenuation
b. Distortion
c. Interference
d. Noise

These are the factors which actually damages the transmission Each of them effects some or other type of media.

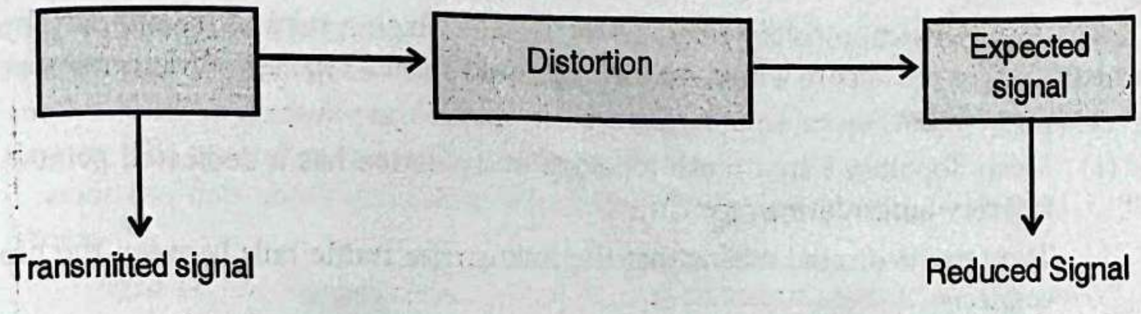
(a) **Attenuation** : This is the fall in signal strength with distance over any transmission medium. For guided medias it is generally logarithmic and thus is typically represented as a constant number of decibels per unit distance. For unguided media it is a more complex function of distance and make up of atmosphere. Beyond a certain distance the attenuation is unacceptably great, and repeaters or amplifiers are used to boost the signal from time to time.



Sources of attenuation are :

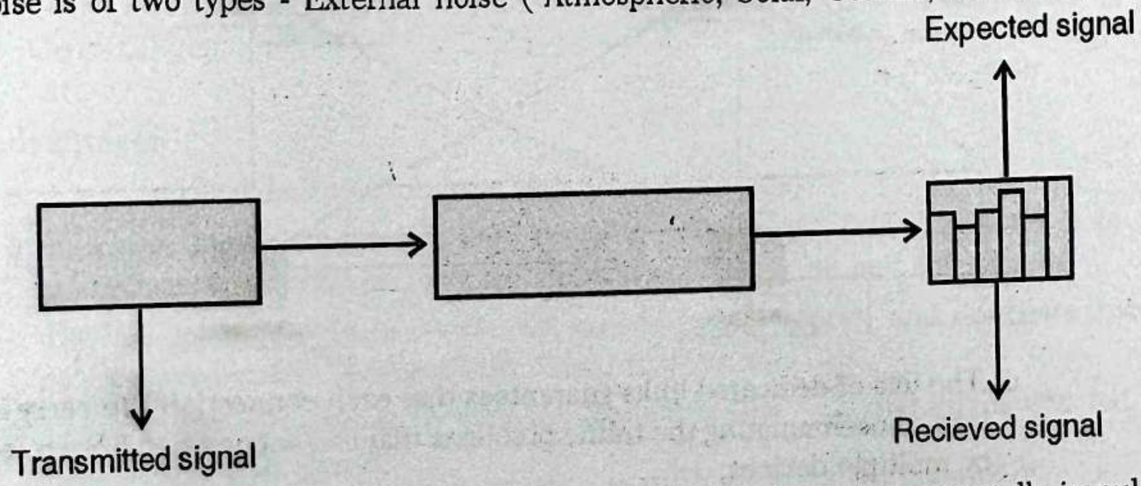
- o Increased resistance
- o Leakage of energy : anything that flows can leak, so electric energy may also leak.
- o Freak Paths : These are created due to climatic conditions
  - Presence of drops of salts in water.
  - Presence of fine cool dust.
  - Slightly acidic atmosphere.

(b) **Distortion** : Distortion is defined as the charge in the wave form. In transmission of analog signal, distortion is dangerous because it effects transmission. But in digital we are not warned about the change in wave form.

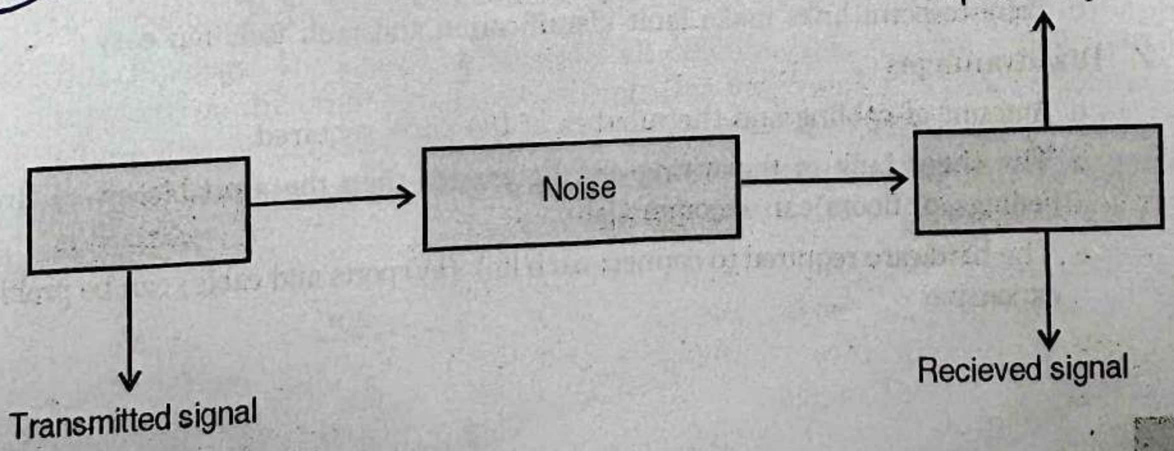

Distortion
Expected signal
Transmitted signal
Reduced Signal

(c) **Interference (delay distortion)**: The distortion is caused by the fact that the velocity of propagation of a signal through a guided medium varies with frequency. For a band limit signal, velocity tends to be highest near the center frequency and fall off towards the two edges of the band. Thus various frequency components will arrive the receiver at different times. This is particularly harmful for the digital data. Because of delay in arrival of some components of signal, slow component of earlier pulse interferes with the earlier component of subsequent pulse. This entirely changes the transmitted signal.

(d) **Noise:** When data is transmitted, the received signal along with transmitted signal receives some unwanted signals also. These unwanted signals are referred to as Noise. Noise is of two types - External noise (Atmospheric, Solar, Cosmic, Industrial) and Internal noise (like Thermal Agitation noise, intermodulation noise, cross talk, impulse noise)


Expected signal
Transmitted signal
Recieved signal

9.1 NETWORK TOPOLOGIES


Expected signal
Noise
Transmitted signal
Recieved signal

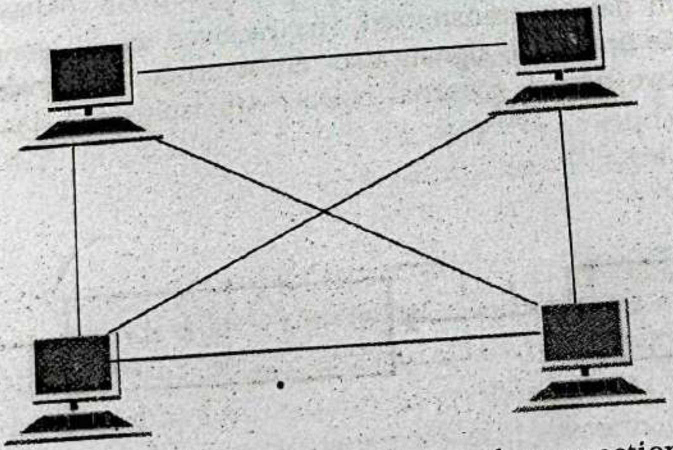
The term physical topology refers to the way in which a network is laid out physically: I/O or more devices connect to a link; two or more links form a topology. Various network topologies are discussed below :

(*i*) **Mesh Topology :** In a mesh topology, every device has a dedicated point-to-point link to every other device.

The term dedicated means that the link carries traffic only between the two devices it connects.

Node 1 must be connected to n - 1nodes, node 2 must be connected to n – 1 nodes, and finally node n must be connected to n - 1 nodes. We need n (n - 1) physical links. However, if each physical link allows communication in both directions, the no of links needed are n(n-1)/2.

✓ **Advantages**

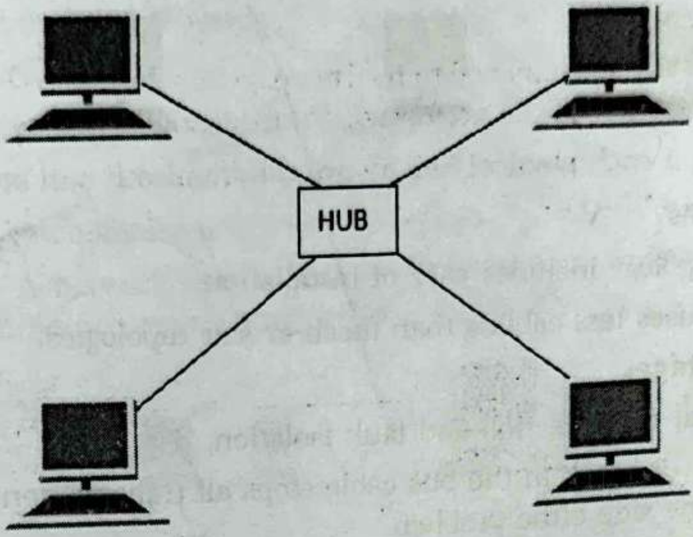


- The use of dedicated links guarantees that each connection can carry its own data load, thuseliminating the traffic problems that can occur when links must be shared by multiple devices.
- A mesh topology is robust. If one link becomes unusable, it does not incapacitate the entiresystem.
- There is the advantage of privacy or security. When every message travels along a dedicatedline, only the intended recipient sees it.
- Point-to-point links make fault identification and fault isolation easy.

✓ **Disadvantages**

- Amount of cabling and the number of I/O ports required.
- The sheer bulk of the wiring can be greater than the available space (in walls, ceilings, or floors)can accommodate.
- The hardware required to connect each link (I/O ports and cable) can be prohibitively expensive.

(ii) **Star Topology:** In a star topology, each device has a dedicated point-to-point link only to a central controller,usually called a hub.The devices are not directly linked to one another. Unlike a mesh topology, a star topology doesnot allow direct traffic between devices. The controller acts as an exchange: If one device wants to send data to another, it sends the data tothe controller, which then relays the data to the other connected device.



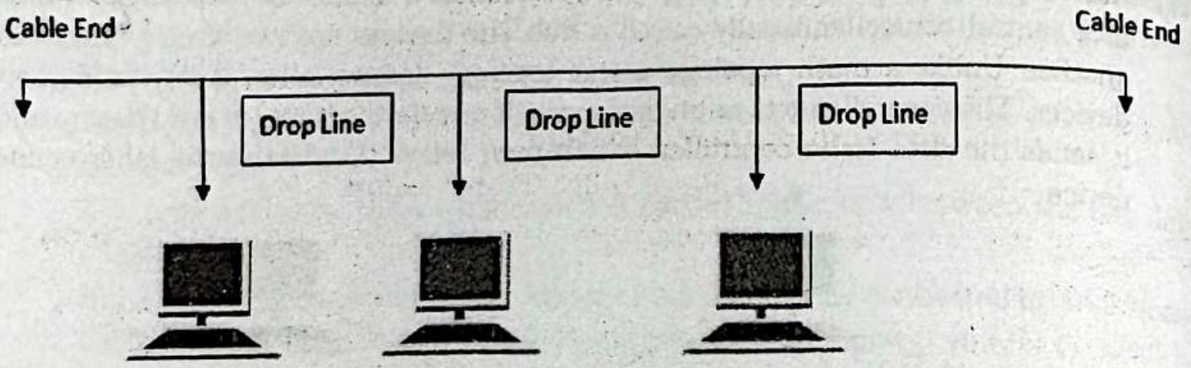
✓ **Advantages**

- A star topology is less expensive than a mesh topology.
- In a star, each device needs only one link and one I/O port to connect it to any number ofothers. This factor also makes it easy to install and reconfigure.
- Far less cabling needs to be housed, and additions, moves, and deletions involve only oneconnection: between that device and the hub.
- Other advantages include robustness. If one link fails, only that link is affected. All other linksremain active.

✓ **Disadvantages**

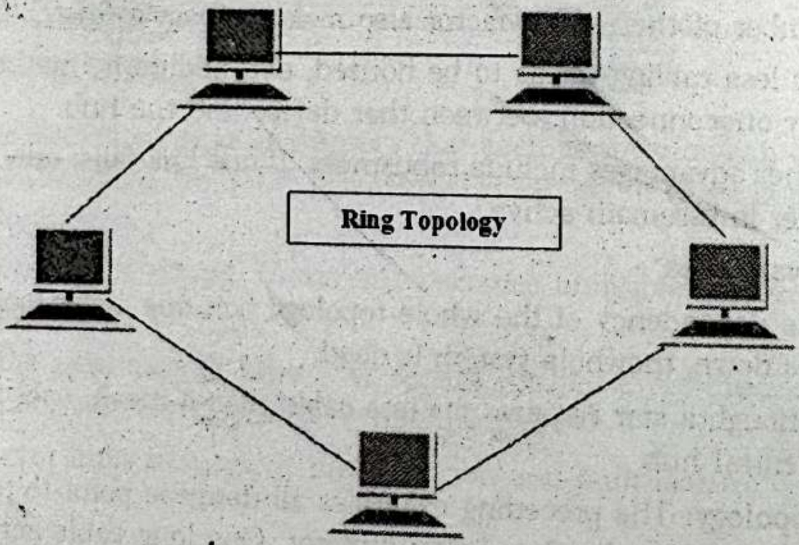
- The dependency of the whole topology bon one single point, the hub. If the hub goes down, thewhole system is dead.
- Although a star requires far less cable than a mesh, each node must be linked to a central hub.

(iii) **Bus Topology:** The preceding examples all describe point-to-point connections. A bus topology, on the other hand, ismultipoint. One long cable acts as a backbone to link all the devices in a network.As a signal travels along the backbone, some of its energy is transformed into heat. Therefore itbecomes weaker and weaker as it travels farther and farther.



- ✓ **Advantages**
  - o Bus topology includes ease of installation.
  - o A bus uses less cabling than mesh or star topologies.
- ✓ **Disadvantages**
  - o Difficult reconnection and fault isolation.
  - o A fault or break in the bus cable stops all transmission, even between devices on the same side ofthe problem.

(*iv*) Ring topology : Ring Topology In a ring topology, each device has a dedicated point-to-point connection with only thetwo devices on either side of it. A signal is passed along the ring in one direction, from device to device,until it reaches its destination.



- ✓ **Advantages**
  - o A ring is relatively easy to install andreconfigure. Fault isolation is simplified.
- ✓ **Disadvantages**
  - o Unidirectional traffic can be a disadvantage.
  - o In a simple ring, a break in the ring (such as a disabled station) can disable the entire network.

(v) **Tree Topology** : It has a root node and all other nodes are connected to it forming a hierarchy. It is also called hierarchical topology. It should at least have three levels to the hierarchy.

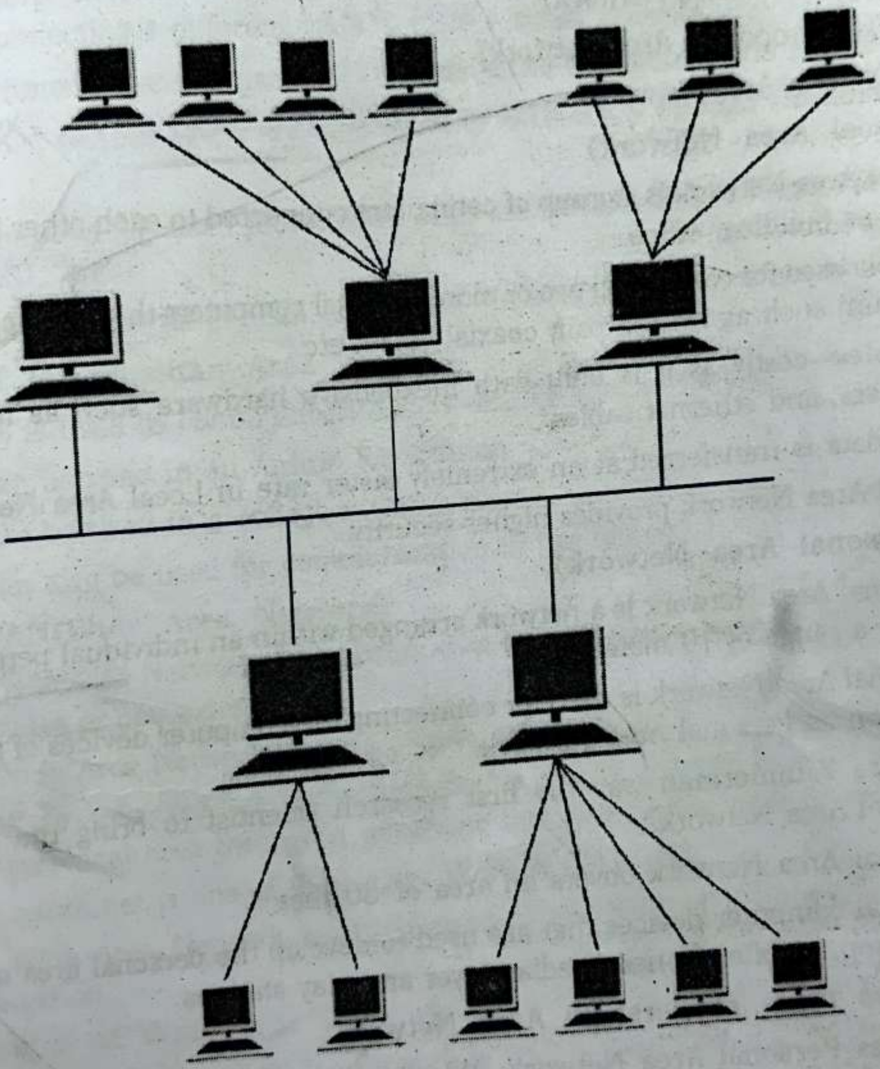
✓ **Advantages**

- o Point-to-point wiring for individual segments.
- o Supported by several hardware and software vendors.
- o All the computers have access to the larger and their immediate networks.

✓ **Disadvantages**

- o Overall length of each segment is limited by the type of cabling used.
- o If the backbone line breaks, the entire segment goes down.
- o More difficult to configure and wire than other topologies.

(vi) **Hybrid Topology**: A network can be hybrid. For example, we can have a main star topology with each branch connectingseveral stations in a bus topology.



✓ **Advantages**

- It is extremely flexible.
- It is very reliable.

✓ **Disadvantages**

- Expensive

9.2 COMPUTER NETWORK

A computer network is a group of computers linked to each other that enables the computer to communicate with another computer and share their resources, data, and applications.

A computer network can be categorized by their size. A computer network is mainly of four types :

- LAN(Local Area Network)
- PAN(Personal Area Network)
- MAN(Metropolitan Area Network)
- WAN(Wide Area Network)

(*i*) LAN(Local Area Network)

- Local Area Network is a group of computers connected to each other in a small area such as building, office.
- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.
- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.

(*ii*) PAN(Personal Area Network)

- Personal Area Network is a network arranged within an individual person, typically within a range of 10 meters.
- Personal Area Network is used for connecting the computer devices of personal use is known as Personal Area Network.
- Thomas Zimmerman was the first research scientist to bring the idea of the Personal Area Network.
- Personal Area Network covers an area of 30 feet.
- Personal computer devices that are used to develop the personal area network are the laptop, mobile phones, media player and play stations.

There are two types of Personal Area Network:

- Wireless Personal Area Network: Wireless Personal Area Network is developed by simply using wireless technologies such as WiFi, Bluetooth. It is a low range network.

- **Wired Personal Area Network:** Wired Personal Area Network is created by using the USB.

✓ **Examples of Personal Area Network:**

- **Body Area Network:** Body Area Network is a network that moves with a person. For example, a mobile network moves with a person. Suppose a person establishes a network connection and then creates a connection with another device to share the information.
- **Offline Network:** An offline network can be created inside the home, so it is also known as a **home network.** A home network is designed to integrate the devices such as printers, computer, television but they are not connected to the internet.
- **Small Home Office:** It is used to connect a variety of devices to the internet and to a corporate network using a VPN

(*iii*) MAN(Metropolitan Area Network)

- A metropolitan area network is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network.
- Government agencies use MAN to connect to the citizens and private industries.
- In MAN, various LANs are connected to each other through a telephone exchange line.
- The most widely used protocols in MAN are RS-232, Frame Relay, ATM, ISDN, OC-3, ADSL, etc.
- It has a higher range than Local Area Network(LAN).

✓ **Uses of Metropolitan Area Network:**

- MAN is used in communication between the banks in a city.
- It can be used in an Airline Reservation.
- It can be used in a college within a city.
- It can also be used for communication in the military.

(*iv*) WAN(Wide Area Network)

- A Wide Area Network is a network that extends over a large geographical area such as states or countries.
- A Wide Area Network is quite bigger network than the LAN.
- A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.
- The internet is one of the biggest WAN in the world.
- A Wide Area Network is widely used in the field of Business, government, and education.

✓ **Examples of Wide Area Network:**

- **Mobile Broadband:** A 4G network is widely used across a region or country.
- **Last mile:** A telecom company is used to provide the internet services to the customers in hundreds of cities by connecting their home with fiber.

  - **Private network:** A bank provides a private network that connects the 44 offices. This network is made by using the telephone leased line provided by the telecom company.

- ✓ **Advantages of Wide Area Network :** Following are the advantages of the Wide Area Network:
  - **Geographical area :** A Wide Area Network provides a large geographical area. Suppose if the branch of our office is in a different city then we can connect with them through WAN. The internet provides a leased line through which we can connect with another branch.
  - **Centralized data:** In case of WAN network, data is centralized. Therefore, we do not need to buy the emails, files or back up servers.
  - **Get updated files:** Software companies work on the live server. Therefore, the programmers get the updated files within seconds.
  - **Exchange messages:** In a WAN network, messages are transmitted fast. The web application like Facebook, Whatsapp, Skype allows you to communicate with friends.
  - **Sharing of software and resources:** In WAN network, we can share the software and other resources like a hard drive, RAM.
  - **Global business:** We can do the business over the internet globally.
  - **High bandwidth:** If we use the leased lines for our company then this gives the high bandwidth. The high bandwidth increases the data transfer rate which in turn increases the productivity of our company.

- ✓ **Disadvantages of Wide Area Network :** The following are the disadvantages of the Wide Area Network:
  - **Security issue:** A WAN network has more security issues as compared to LAN and MAN network as all the technologies are combined together that creates the security problem.
  - **Needs Firewall & antivirus software:** The data is transferred on the internet which can be changed or hacked by the hackers, so the firewall needs to be used. Some people can inject the virus in our system so antivirus is needed to protect from such a virus.
  - **High Setup cost:** An installation cost of the WAN network is high as it involves the purchasing of routers, switches.
  - **Troubleshooting problems:** It covers a large area so fixing the problem is difficult.

9.2.1. Advantages of Network

These are main advantages of Computer Networks :

1. **Central Storage of Data** –Files can be stored on a central node (the file server) that can be shared and made available to each and every user in an organization.
2. **Anyone can connect to a computer network** –There is a negligible range of abilities required to connect to a modern computer network. The effortlessness of joining makes it workable for even youthful kids to start exploiting the data.

3. **Faster Problem solving** –Since an extensive procedure is disintegrated into a few littler procedures and each is taken care of by all the associated gadgets, an explicit issue can be settled in lesser time.
4. **Reliability** –Reliability implies backing up of information. Due to some reason equipment crash, and so on, the information gets undermined or inaccessible on one PC, another duplicate of similar information is accessible on another workstation for future use, which prompts smooth working and further handling without interruption.
5. **It is highly flexible** –This innovation is known to be truly adaptable, as it offers clients the chance to investigate everything about fundamental things, for example, programming without influencing their usefulness.
6. **Security through Authorization** –Security and protection of information is additionally settled through system. As just the system clients are approved to get to specific records or applications, no other individual can crack the protection or security of information.
7. **It boosts storage capacity** –Since you will share data, records and assets to other individuals, you need to guarantee all information and substance are legitimately put away in the framework. With this systems administration innovation, you can do the majority of this with no issue, while having all the space you requirement for capacity.

9.2.2 Disadvantages of Network

These are main disadvantages of Computer Networks :

1. **It lacks robustness** –If a PC system's principle server separates, the whole framework would end up futile. Also, if it has a bridging device or a central linking server that fails, the entire network would also come to a standstill. To manage these issues, gigantic systems ought to have a ground-breaking PC to fill in as document server to influence setting to up and keeping up the system less demanding.
2. **It lacks independence** –PC organizing includes a procedure that is worked utilizing PCs, so individuals will depend a greater amount of PC work, rather than applying an exertion for their jobs that needs to be done. Beside this, they will be subject to the primary document server, which implies that, in the event that it separates, the framework would end up futile, making clients inactive.
3. **Virus and Malware** –On the off chance that even one PC on a system gets contaminated with an infection, there is a possibility for alternate frameworks to get tainted as well. Infections can spread on a system effectively, in view of the between availability of different gadgets.4. Lack of Independence
4. **Cost of network** –The expense of executing the system including cabling and equipment can be expensive.

9.3 INTERNET, EXTRANET, INTRANET

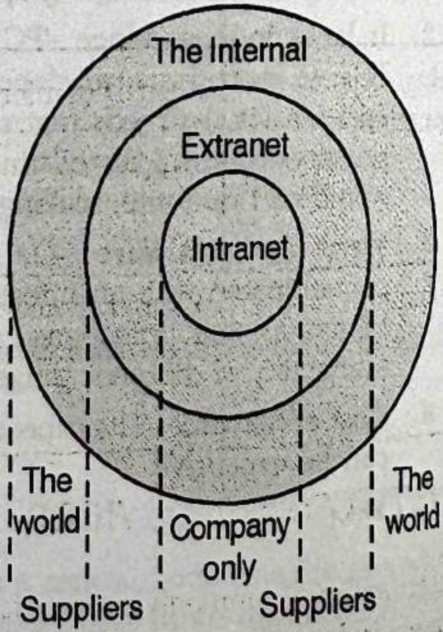
Though used on a daily basis by people all around the world, a thorough understanding of what the internet is lacking for most of its users. The internet can best be seen as a community of computers that are allowed to connect to each other, and any computer on the internet can connect any other computer at any time it wishes. Through infrastructure that spans the globe, there is one single, unified internet that all computers connect to, allowing anyone connected to share and access all the information that they choose to. While humans are often using computers in the traditional sense (with a mouse, keyboard, and monitor), many of the other 'computers' we connect to are most often servers, which act as holding stations that store all the data that is being accessed.

The Internet functions via several major hubs throughout the world, where they connect and are able to connect to other major hubs. Primarily ordered and managed by the United States, a person sitting in California that is connected to the internet can access servers anywhere else around the world that are also connected. Because servers are physically located throughout the world, this is why some websites are able to return information faster than others - a server in a nearby city does not have to send data as far as a server thousands of miles away.

Intranet : Intranet is a restricted version of the internet, that typically does not allow access to anyone outside of its network. An intranet is typically a local only network, meaning only people who are directly wired to the intranet can access the information stored on its servers. Intranets may be used for organizations or networks that do not want their information to be able to be accessed by outside sources and is especially important for organizations that require a high amount of secrecy - such as a server that holds military secrets or a database. Intranets are basically mini versions of the internet that connect just a few servers, instead of the countless number of servers that the internet holds and connects with one another.

Extranet : Internet and an intranet are not always separate and clear cut, and anything that is a blend of the two is considered an extranet. An extranet is a private intranet (or local network) that is connected to the Internet, but only allows access to certain information or access by certain groups of people. The extranet is a blend of the secrecy and control allowed to an intranet, but also the convenience and sheer amount of information enjoyed by using the internet.

Extranets, however, are not perfect, and almost any network connected to the internet can be accessed inappropriately given enough time, motivation, and resources by an interested party. If a hacker with the right skill set decides to access an extranet, the question is more a matter of when they will be able to get past security measures and access it, rather than if they will be able to.



✓ **Difference between Internet, Intranet and Extranet**

Basis of Comparison	Internet	Intranet	Extranet
Type of Network	Public, i.e. it is global system of inter-connected compute network	Private *i.e.* it is specific to an org-anization.	Private/VPN *i.e.* it uses public network to share information with suppliers and vendors.
Regulation	Not regulated by any authority	It is regulated by an organization	It is regulated by many organization
Accessibility	The content of the network is accessible to everyone connected	The content of the network is accessible to only the members of the organization.	The content of the network is accessible tothe members of the organization and external members with access to network
Size of network	It is largest in terms of number of connected devices	It is small network with minimal number of connected devices	It is small network with minimal number of connected devices (but more than intranet)
Ownership	It is owned by no one.	It is owned by single organization.	It is owned by multiple organization.
Sharing of information	Sharing of information is throughout the world	Sharing sensitive information throughout the organization	Sharing sensitive information throughout the organization and external members
Authenticity	Users can access over Internet anonymously	Valid username and password are required to access Intranet	Valid username and password are required to access Extranet

9.4 NETWORKING DEVICES

Internetworks commonly use special devices called repeaters, bridges, routers, and gateways to connect independent networks. Local area networks occasionally use these devices to extend connections within a local area network. Some of these are discussed below:

(i) **Repeater** : A repeater operates at the physical layer. As its name implies, a repeater copies or repeats signals that it receives. However, a repeater also amplifies all received signals before retransmission. This means a repeater increases the size of analog waveforms (but only to its original strength) it receives. By increasing the size of the waveform (without changing its frequency), a repeater eliminates the signal loss or attenuation that the waveform experienced during its journey to the repeater. In short, a repeater strengthens an incoming signal before sending the signal on its way. By strategically placing repeaters along a network bus, engineers can extend the distance between adjacent computers.

Long-haul networks may contain many repeaters. Ethernets also frequently use repeaters to extend the length of the bus cable within a local area network. That is, network administrators use repeaters to avoid attenuation problems when they connect two pieces of the same network. In other words, although you can use a repeater as part of an internetwork connection, you can also use repeaters within a single, stand-alone network such as a LAN.

(ii) Bridge: A bridge operates at data link layer. A bridge is a repeater, with add on functionality of filtering content by reading the MAC addresses of source and destination. It is also used for interconnecting two LANs working on the same protocol. For example, assume a bridge interconnects two networks called "Eastside" and "Westside." The bridge will examine all packets on each network data bus. When the bridge sees an Eastside packet destined for an address on the Westside network, the bridge transfers the packet from the Eastside network to the Westside network. The bridge will not transmit a packet to the Westside network if the packet's destination address is on the Eastside network.

In other words, a bridge acts like a traffic cop at a busy intersection beside a bridge that crosses a river. The traffic cop (the bridge) asks the occupants of each vehicle (the Eastside packet) where they want to go. If the occupants specify an address on the other (Westside address), the traffic cop directs the vehicle across the bridge (to the Westside network). If the occupants specify an Eastside address, the traffic cop waves the vehicle through the intersection. The traffic cop (bridge) only redirects traffic (packets) destined for an address located on the other side of the river (the Westside address). Bridges also boost performance, reliability and security.

✓ **Types of Bridges**

- o **Transparent Bridges** : - These are the bridge in which the stations are completely unaware of the bridge's existence i.e. whether or not a bridge is added or deleted from the network , reconfiguration of the stations is unnecessary. These bridges make use of two processes i.e. bridge forwarding and bridge learning.
- o **Source Routing Bridges** : - In these bridges, routing operation is performed by source station and the frame specifies which route to follow. The hot can discover frame by sending a special frame called discovery frame, which spreads through the entire network using all possible paths to destination.

(iii) Gateway – A gateway, as the name suggests, is a passage to connect two networks together that may work upon different networking models. They basically works as the messenger agents that take data from one system, interpret it, and transfer it to another

system. Gateways are also called protocol converters and can operate at any network layer. Gateways are generally more complex than switch or router.

(*iv*) **Router:** A router transfers or routes data between networks. Although a router can transfer data between networks that use the same technologies, routers commonly transfer data between different technologies such as Ethernet and IBM Token ring. Since the internet consists of thousands of networks that use many different technologies, routers are an essential part of the Internet. A router has an address on the network; a bridge does not. This difference is the key to understanding the difference between a bridge and a router. Networks frequently use a router as an intermediate destination.

In other words, a computer can send a packet destined for another network to a router. The router will transfer the packet to the other network. On the other hand, a bridge must examine all data on the bus to determine which packets to transfer between networks. As such, computers never send packets directly to the bridge — doing so is unnecessary. A router never examines a packet on the data bus unless the packet contains the router's address.

✓ Routing Techniques

Computer networks may use one of the following routing techniques:

- **Circuit Switching:** Circuit switching is analogous to a simple telephone call. A physical circuit is established between the two machines. Once the connection is established, the data transfer takes place and then the connection is released. Now, another location can be dialled and a new circuit can be established. The transfer of data using this type of switching technique is very fast but it is error prone. It is the responsibility of the user to check for errors and the integrity of the data.
- **Packet Switching:** A Packet switching network divides the data to be transmitted into packets which are of a fixed size and carry error checking information with them. Each packet of data contains the address of its final destination when it is transmitted. As the packet moves through intermediate machines, it is inspected for its address and is accordingly routed to another intermediate machine. Messages being transmitted through this type of network are less error prone than those transferred through circuit switching networks. In case a particular packet is found corrupt on arrival, the destination machine can request the source machine for its retransmission.
- **Message Switching:** In a Message switching network, the message as a whole is transmitted, i.e. it is not divided into packets. Each message contains the address of its final destination and it is upto the intermediate machines as to what path they want the message to go through. The message 'switching network is a store and forward network. until the message arrives at an intermediate machine it is stored in the machine tr: the output line is free, and then transmitted. In case of heavy traffic on the transmission line, the messages are queued up and accordingly dispatched when their turn comes.

(*v*) **Brouters** : Many routers are really Brouters. It can work either at data link layer or at network layer. Brouters are essentially routers that can also bridge. A brouter will first check to see if it supports the protocol being used by the packet. If not, rather than simply dropping the packet, the packet is bridged using physical address information.

(*vi*) **Switch** – A switch is a multi-port bridge with a buffer and a design that can boost its efficiency (large number of ports imply less traffic) and performance. Switch is data link layer device. Switch can perform error checking before forwarding data, that makes it very efficient as it does not forward packets that have errors and forward good packets selectively to correct port only. In other words, switch divides collision domain of hosts, but broadcast domain remains same.

(*vii*) Hub : The network hub is a centralized distribution point for all traffic on a single leg of the actual network. It is like a warehouse distribution center. Data packets from a NIC arrive at hub which receives and rebroadcasts them to other computers connected to it. But a network hub is not smart. It does not know where the destination of data packet is and so, must send a copy to all the connections on the hub. Hubs can be classified as:

- o Stackable versus Non-stackable
- o Active versus Passive
- o Intelligent versus Non-intelligent (dumb)

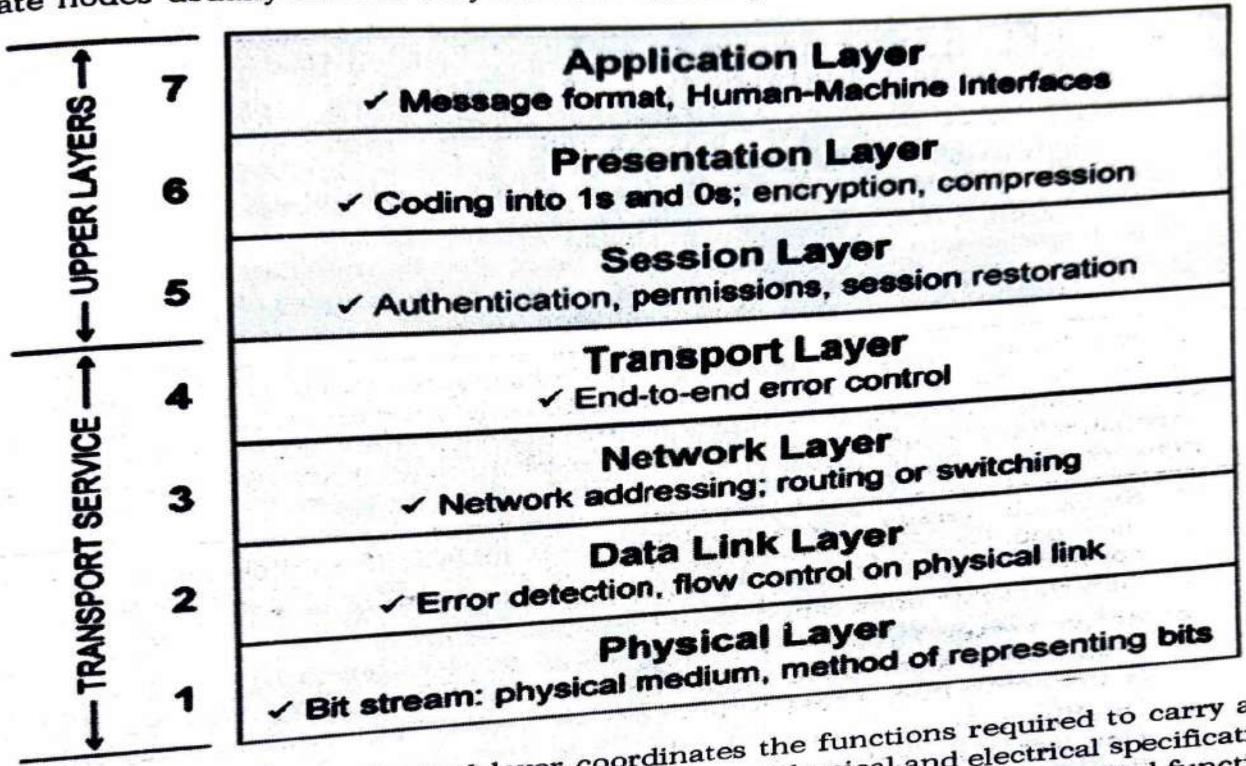
> A Network Interface Card (NIC) is a computer hardware component that allows a computer to connect to a network. NICs may be used for both wired and wireless connections.A NIC is also known as a network interface controller (NIC), network interface controller card, expansion card, computer circuit board, network card, LAN card, network adapter or network adapter card (NAC).

- o **Stackable versus Non-stackable**: Stackable versus non-stackable is one of the two most popular terms vendors use to classify their hubs. Stackable hubs can be stacked and connected (usually through a proprietary interface part) so they appear as a single hub. Non-stackable hubs cannot be interconnected.
- o **Active versus Passive**: The terms active and passive are used to describe the role of each hub in a stackable set of hubs. The hub that connects to the network backbone is the active hub. Those which connect only to the active hub are passive hubs.
- o **Intelligent versus Dumb**: Intelligent hubs often cost much more than dumb hubs. However, that higher cost includes SNMP (Simple Network Management Protocol) firmware you can access remotely. SNMP is a polling protocol that allows you to obtain network performance and status data from hubs.

9.5 OSI MODEL

The OSI model is based on a proposal developed by the International Standards Organization (ISO) as a first step toward international standardization of the protocols used in the various layers (Day and Zimmermann, 1983). It was revised in 1995(Day, 1995). The model is called the ISO-OSI (Open Systems Interconnection) Reference Model because it deals with connecting open systems—that is, systems that are open for communication with other systems. The OSI model is a layered framework for the design of network systems that allows communication between all types of computer systems. It consists of seven separate but related layers, each of which defines a part of the process of moving information across a network.

The OSI model is composed of seven ordered layers: physical (layer 1), data link (layer 2), network (layer 3), transport (layer 4), session (layer 5), presentation (layer 6), and application (layer 7). Figure below shows the layers involved when a message is sent from device A to device B. As the message travels from A to B, it may pass through many intermediate nodes. These intermediate nodes usually involve only the first three layers of the OSI model.


UPPER LAYERS
TRANSPORT SERVICE
7
Application Layer
✓ Message format, Human-Machine Interfaces
6
Presentation Layer
✓ Coding into 1s and 0s; encryption, compression
5
Session Layer
✓ Authentication, permissions, session restoration
4
Transport Layer
✓ End-to-end error control
3
Network Layer
✓ Network addressing; routing or switching
2
Data Link Layer
✓ Error detection, flow control on physical link
1
Physical Layer
✓ Bit stream: physical medium, method of representing bits

1. ***Physical Layer*** : The physical layer coordinates the functions required to carry a bit stream over a physical medium. It deals with the mechanical and electrical specifications of the interface and transmission medium. It also defines the procedures and functions that physical devices and interfaces have to perform for transmission to occur.

   The physical layer is also concerned with the following:

   - **Physical characteristics of interfaces and medium**. The physical layer defines the characteristics of the interface between the devices and the transmission medium. It also defines the type of transmission medium.
   - **Representation of bits**. The physical layer data consists of a stream of bits (sequence of 0s or 1s) with no interpretation. To be transmitted, bits must be encoded into signals—electrical or optical. The physical layer defines the type of encoding.
   - **Data rate**. The transmission rate-the number of bits sent each second-is also defined by the physical layer. In other words, the physical layer defines the duration of a bit, which is how long it lasts.

- o **Synchronization of bits.** The sender and receiver not only must use the same bit rate but also must be synchronized at the bit level. In other words, the sender and the receiver clocks must be synchronized.
- o **Line configuration.** The physical layer is concerned with the connection of devices to the media. In a point-to-point configuration, two devices are connected through a dedicated link. In a multipoint configuration, a link is shared among several devices.
- o **Physical topology.** The physical topology defines how devices are connected to make a network. Devices can be connected by using a mesh topology (every device is connected to every other device), a star topology (devices are connected through a central device), a ring topology (each device is connected to the next, forming a ring), a bus topology (every device is on a common link), or a hybrid topology (this is a combination of two or more topologies).
- o **Transmission mode.** The physical layer also defines the direction of transmission between two devices: simplex, half-duplex, or full-duplex. In simplex mode, only one device can send; the other can only receive. The simplex mode is a one-way communication. In the half-duplex mode, two devices can send and receive, but not at the same time. In a full-duplex (or simply duplex) mode, two devices can send and receive at the same time.

2. ***Data Link Layer*** : The data link layer transforms the physical layer, a raw transmission facility, to a reliable link. It makes the physical layer appear error-free to the upper layer (network layer).

   Other responsibilities of the data link layer include the following:

   - o **Framing.** The data link layer divides the stream of bits received from the network layer into manageable data units called frames.
   - o **Physical addressing.** If frames are to be distributed to different systems on the network, the data link layer adds a header to the frame to define the sender and/or receiver of the frame. If the frame is intended for a system outside the sender's network, the receiver address is the address of the device that connects the network to the next one.
   - o **Flow control.** If the rate at which the data are absorbed by the receiver is less than the rate at which data are produced in the sender, the data link layer imposes a flow control mechanism to avoid overwhelming the receiver.
   - o **Error control.** The data link layer adds reliability to the physical layer by adding mechanisms to detect and retransmit damaged or lost frames. It also uses a mechanism to recognize duplicate frames. Error control is normally achieved through a trailer added to the end of the frame.
   - o **Access control.** When two or more devices are connected to the same link, data link layer protocols are necessary to determine which device has control over the link at any given time.

3. ***Network Layer :*** The network layer is responsible for the source-to-destination delivery of a packet, possibly across multiple networks (links). Whereas the data link layer oversees the delivery of the packet between two systems on the same network (links),

the network layer ensures that each packet gets from its point of origin to its final destination. If two systems are connected to the same link, there is usually no need for a network layer. However, if the two systems are attached to different networks (links) with connecting devices between the networks (links), there is often a need for the network layer to accomplish source-to-destination delivery.

Other responsibilities of the network layer include the following:

- **Logical addressing**. The physical addressing implemented by the data link layer handles the addressing problem locally. If a packet passes the network boundary, we need another addressing system to help distinguish the source and destination systems. The network layer adds a header to the packet coming from the upper layer that, among other things, includes the logical addresses of the sender and receiver.
- **Routing**. When independent networks or links are connected to create *intemetworks*(network of networks) or a large network, the connecting devices (called *routers* or *switches*) route or switch the packets to their final destination. One of the functions of the network layer is to provide this mechanism.

4. ***Transport Layer*** : The transport layer is responsible for process-to-process delivery of the entire message. A process is an application program running on a host. Whereas the network layer oversees source- to-destination delivery of individual packets, it does not recognize any relationship between those packets. It treats each one independently, as though each piece belonged to a separate message, whether or not it does. The transport layer, on the other hand, ensures that the whole message arrives intact and in order, overseeing both error control and flow control at the source- to-destination level.

   Other responsibilities of the transport layer include the following:

   - **Service-point addressing**. Computers often run several programs at the same time. For this reason, source-to-destination delivery means delivery not only from one computer to the next but also from a specific process (running program) on one computer to a specific process (running program) on the other. The transport layer header must therefore include a type of address called a *service-point address* (or port address). The network layer gets each packet to the correct computer; the transport layer gets the entire message to the correct process on that computer.
   - **Segmentation and reassembly**. A message is divided into transmittable segments, with each segment containing a sequence number. These numbers enable the transport layer to reassemble the message correctly upon arriving at the destination and to identify and replace packets that were lost in transmission.
   - **Connection control**. The transport layer can be either connectionless or connection oriented. A connectionless transport layer treats each segment as an independent packet and delivers it to the transport layer at the destination machine. A connection oriented transport layer makes a connection with the transport layer at the destination machine first before delivering the packets. After all the data are transferred, the connection is terminated.
   - **Flow control**. Like the data link layer, the transport layer is responsible for flow control. However, flow control at this layer is performed end to end rather than across a single link.

- **Error control**. Like the data link layer, the transport layer is responsible for error control. However, error control at this layer is performed process-to-process rather than across a single link. The sending transport layer makes sure that the entire message arrives at the receiving transport layer without error (damage, loss, or duplication). Error correction is usually achieved through retransmission.

5. *Session Layer* : The services provided by the first three layers (physical, data link, and network) are not sufficient for some processes. The session layer is the network *dialog controller*. It establishes, maintains, and synchronizes the interaction among communicating systems.

   Specific responsibilities of the session layer include the following:

   - **Dialog control**. The session layer allows two systems to enter into a dialog. It allows the communication between two processes to take place in either half duplex (one way at a time) or full-duplex (two ways at a time) mode.
   - **Synchronization**. The session layer allows a process to add checkpoints, or synchronization points, to a stream of data.

6. *Presentation Layer* : The presentation layer is concerned with the syntax and semantics of the information exchanged between two systems.

   Specific responsibilities of the presentation layer include the following:

   - **Translation**. The processes (running programs) in two systems are usually exchanging information in the form of character strings, numbers, and so on. The information must be changed to bit streams before being transmitted. Because different computers use different encoding systems, the presentation layer is responsible for interoperability between these different encoding methods. The presentation layer at the sender changes the information from its sender-dependent format into a common format. The presentation layer at the receiving machine changes the common format into its receiver-dependent format.
   - **Encryption**. To carry sensitive information, a system must be able to ensure privacy. Encryption means that the sender transforms the original information to another form and sends the resulting message out over the network. Decryption reverses the original process to transform the message back to its original form.
   - **Compression**. Data compression reduces the number of bits contained in the information. Data compression becomes particularly important in the transmission of multimedia such as text, audio, and video.

7. *Application Layer* : The application layer enables the user, whether human or software, to access the network. It provides user interfaces and support for services such as electronic mail, remote file access and transfer, shared database management, and other types of distributed information services.

   Specific services provided by the application layer include the following:

   - **Network virtual terminal**. A network virtual terminal is a software version of a physical terminal, and it allows a user to log on to a remote host.

- **File transfer, access, and management.** This application allows a user to access files in a remote host (to make changes or read data), to retrieve files from a remote computer for use in the local computer, and to manage or control files in a remote computer locally.
- **Mail services.** This application provides the basis for e-mail forwarding and storage.
- **Directory services.** This application provides distributed database sources and access for global information about various objects and services.

REVIEW QUESTIONS

1. Describe the various components of Data communication model.
2. Differentiate between analog and digital signal.
3. Discuss the various modes of data transmission.
4. Explain the various methods of data transmission
5. Elaborate with advantages and disadvantages various networking topologies.
6. Differentiate Internet, Intranet and Extranet
7. Explain the various Networking devices.
8. Describe OSI model in detail.
9. Write short notes on:
    - Internet
    - Intranet
    - Extranet
    - Routing techniques
    - LAN
    - MAN
    - WAN
    - PAN
    - Advantages of computer network
    - Disadvantages of computer network
    - Modulation and Demodulation

10

CHAPTER

Information Technology and Society

LEARNING OUTCOMES

- ☐ Application of IT in Railways
- ☐ Application of IT in Airlines
- ☐ Application of IT in Banking
- ☐ Application of IT in Insurance
- ☐ Application of IT in Inventory Control
- ☐ Application of IT in Financial System
- ☐ Application of IT in Hotel management
- ☐ Application of IT in Education
- ☐ Application of IT in Entertainment
- ☐ Application of IT in Health

10.0 APPLICATION OF IT IN RAILWAYS

One of the most important contributions of IT in railways is in the domain of customer service and access to information. Railway systems are integrated with efficient and real-time frontend IT platforms for improvised customer services. Modern railway systems must deal with massive commuters and an increasing transportation of goods. Moreover, the need of better services has increased with the requirement of more pervasive railway services. Real time information system is a crucial aspect of customer service. Passenger inquiry about availability of trains, arrival and departure schedules at stations and status of booked tickets are some of the aspects that serves as parameters of customer satisfaction of railway services. In fact, they are the most important facets for access to railway service. For a huge and complicated railway network system such as India, efficient use of IT can certainly make a difference. Passenger ticketing and inquiry systems are being developed to be highly service oriented to provide an "ease of access" to customers. In present times, railway information systems are being integrated to mobile services. Adding to this, many web applications are being developed through which railway services can be accessed via mobile devices.

Some of the advantages of IT in railway system are :

- Proliferation of cash accepting Automatic Ticket Vending Machines;
- Ticketing on mobile phones in the unreserved segment;
- PNR status update to passengers through system generated SMS;
- An update for train running information; Online booking of retiring rooms at all important stations;
- Online booking of meals on trains for selected en-route stations;
- Introduction of e-forwarding note and electronic transmission of railway receipts for freight customers, which will enable users to carry out freight business with Railways from the comfort of their homes and offices; and
- Computerisation of claims settlement process on Indian Railways.

10.1 APPLICATION OF IT IN AIRLINES

The airline industry is developing by leaps and bounds due to the revolutionary improvements in the internet technology world. It has fully altered the form, structure, and future of aviation in all ways. Even in future, it is believed that there are several areas of this industry which will experience pioneering technological changes due to the developments that are happening.

✓ Importance of Technology for the industry:

- Operational efficiency : Flight delays and operational inefficiencies are not just annoying for the flyers, but also cost a great deal of dollars for the airline industry. Digital applications can considerably reduce the instances of operational malfunctions. E.g. they can notify the engineers on the maintenance required even before a plane touches down, through digital twins simulating the wear and tear on an aircraft's systems and parts.
- Personalisation : For airlines, customer interactions start way before the flight is even boarded; the test begins when the flyer is looking for a flight and extends way after they unboard the plane. It can be a daunting task to keep up with the changing customer demands and provide a seamless and delightful experience throughout the passenger journey. Technology provides enough customer data enabling airlines to get to know their customers well. Digital applications can help airlines personalise customer experience across every touch point. Technology can delight customers with customised offers, easy and faster check-ins, providing options to track and control their luggage remotely so on and so forth.
- Cost efficiency : Even minimal changes in fuel efficiency, reduction in operational and training costs etc. can save huge costs for the sector. Digitisation can help airlines in reducing the environmental implications due to the increase in air traffic. For instance,

pilots can follow pre-programmed landing patterns that save energy and improve safety, while airlines can also analyse this data to optimise routes and altitudes to reduce emissions.

Importance of Technology for the Flyers

- **Search and Navigation:** With the advent of technology it is easy for customers to search for the flights online and even by using mobile apps.Navigation on site makes easy for all kinds of passengers, to know the itinerary of their travel.
- **Booking & Payment:** Technology makes it easy for the customers to book and pay for their tickets online. With a click a person can book a ticket on the go. Queuing for an hour to book a flight to this destination is not logical. The internet has helped a great deal to ensure customers can simply organize for flights from wherever they are. It is also possible to cancel the flight through the use of the mobile phone or any other technology gadget. The exercise will just take a few minutes compared to the cumbersome paperwork. So, technology has made the booking process more cos and time effective.
- **Easing out the check-in process:**Now-a-days it is important that customer service must be comprehensive to ensure they get all information they want. Technology has helped a great deal since passengers can use the internet to check-in online. Technology literally starts before passengers reach the airport. It has allowed for boarding without cumbersome paperwork. It allows for remote and also express bag drops, self bag tagging among other things. This has helped a great deal in saving time and making the different facilities on the airport more operationally efficient.
- **In-flight app experience:** Technology make the in-flight experience of the customers more entertaining. With the help of technology advancement, passengers are able to control the in-flight entertainment system from a supplied 7" tablet.

10.2 APPLICATION OF IT IN BANKING

The sector that has been most radically affected by the information technology developments is the banking system. The information technology has become a critical business resource because its absence could result in poor decisions and ultimately business failure. Technology has opened up new markets, new products, new services and efficient delivery channels for the banking industry. Information Technology has also provided banking industry with the ability to deal with the challenges the new economy poses. Information technology has been the keystone of recent financial sector reforms aimed at increasing the speed and reliability of financial operations and of initiatives to strengthen the banking sector. The IT revolution has set the stage for unprecedented increase in financial activity across the globe. The progress of technology and the development of worldwide networks have significantly reduced the cost of global funds transfer.

It is information technology which enables banks in meeting such high expectations of the customers who are more demanding and are also more techno-savvy. They demand instant, anytime and anywhere banking facilities. Also, information technology has been providing solutions to banks to take care of their accounting and back office requirements. This has, however, now given way to large scale usage in services aimed at the customer of the banks. IT also facilitates the introduction of new delivery channels—in the form of Automated Teller Machines, Net

Banking; Credit Card Online; Mobile Banking; e-Monies Electronic Fund Transfer; Online Payment of Excise & Service Tax; Bill Payment; Shopping; Ticket Booking; Railway Ticket Booking through SMS; Prepaid Mobile Recharge; Smart Money Order; Card to Card Funds Transfer etc. Further, IT deployment has assumed such high levels that it is no longer possible for banks to manage their IT implementations on a standalone basis with IT revolution, banks are increasingly interconnecting their computer systems not only across branches in a city but also to other geographic locations with high-speed network infrastructure and setting up local area and wide area networks and connecting them to the Internet. As a result, information systems and networks are now exposed to a growing number.

✓ **Importance of Technology to the Bank :**

- Innovative, scheme, addresses competition and present the bank as technology driven in the banking sector market
- Reduces customer visits to the branch and thereby human intervention
- Inter-branch reconciliation is immediate thereby reducing chances of fraud and misappropriation
- On-line banking is an effective medium of promotion of various schemes of the bank, a marketing tool indeed.
- Integrated customer data paves way for individualised and customised services.

✓ **Importance of Technology to the Customer:**

- Anywhere Banking no matter wherever the customer is in the world. Balance enquiry, request for services, issuing instructions etc., from anywhere in the world is possible.
- Anytime Banking – Managing funds in real time and most importantly, 24 hours a day, 7days a week.
- Convenience acts as a tremendous psychological benefit all the time.
- Brings down "Cost of Banking" to the customer over a period a period of time.
- Cash withdrawal from any branch / ATM
- On-line purchase of goods and services including online payment for the same.

10.3 APPLICATION OF IT IN INSURANCE

Information technology has become very important in every industry, and its dissertation lets to determine its significance in the insurance sector too. The insurance sector is purely information-based market, therefore gathering, processing, storing and distributing a vast amount of information emerged needs the implementation of technology. The information technology helps companies to be more effective and efficient.

✓ **Importance of Technology to Insurance sector**

- Maintaining the database : The most important factor that is affecting the insurance industry is the maintaining the database of the customers. The insurance industry have a huge list of the customers. In order to maintain it in manual format it is really the cumbersome work. But with the development of the technology it has become possible to maintain such huge database very easily. A person can switch over to the computer and get the details of the customer very easily.

- **Identifying customer's needs** : Using technology, help insurers closely analyze customer data and identify their needs and risks. With the increase n the number and variety of the insurance policies, it is difficult for insurers to find out the best policy as per the customer's needs; but technology makes this task easy as now people can compare number of policies on internet.
- **Billing efficiency** : Billing systems are not only integrated but now can accept varied forms of payments allowing ultimate flexibility to the customer and thereby making the billing systems efficient. The automated systems can inform and remind customers of approaching due dates for premiums thereby lowering unintentional defaults.
- **Using Big Data to Improve Claim Processing Capabilities** : Big data enables companies to recognize and report events in the fast & effective way for claim assessment activity.
- Auto insurers are drifting towards usage-based insurance, which will assist them in enhancing claim handling capabilities, to do better customer segmentation.
- The insurance firms also use aerial and digital imagery which has a high potential to become a primary tool for insurers to assess properties.

10.4 APPLICATION OF IT IN INVENTORY CONTROL

Any business that sells products needs a reliable method for inventory management. With bar codes, point-of-sale software and warehouse tracking, computerized inventory management systems make it easy for businesses to stay updated consistently. Therfore, using the latest technology to improve the inventory control can streamline the business, reduce costs, and ultimately increase productivity.

Importance of IT for Inventory/Stock Control

- **Automated Reordering and In-Stock Information**

  Computerized inventory informs employees and customers within seconds whether an item is in stock. Because the inventory is synced with sales, there is a running tally of what is in stock and what isn't. This helps flag reordering needs and provides better service to customers. As inventory drops below a specific threshold, new orders are placed with vendors and tracked to let customers know when the new products will arrive.
- **Integration with Accounting**

  Many of the computerized inventory platforms integrate with accounting software to track cash flow. This makes the process of transferring inventory costs and assets between programs seamless and reduces the need for additional bookkeeping costs. Financial statements are more easily generated with shared data between inventory and bookkeeping.
- **Forecasting and Planning**

  Inventory management software does more than track where inventory is located and when to reorder it. A data collection system is used to create needed forecasting and strategic planning reports. Business owners review trends regarding which products do well in certain months or during specific cyclical seasons. Business owners use this data to plan for growth and order inventory intelligently to best utilize cash flow resources. Integrating the stock management to IT can also help the business to work out how much inventory is needed to meet demand. This will aid in avoiding shortages that can slow up the business and prevent the customers from ordering what they want, when they want it. It will also assist in making sure that business don't have too much surplus at any one time on slow-moving products.

- **Increasing Productivity**

  Stock management software, processes, and mobile warehouse technology like barcode scanners, will help to improve the efficiency of the business. Such tools help to reduce manual processes, so that staff can focus on other tasks and reduce errors.

It can also help to streamline the stock-taking process, thereby reducing the amount of time they take, and the hours employees have to invest.

10.5 APPLICATION OF IT IN FINANCIAL SYSTEM

Information technology has many uses in finance. From trading financial instruments to keeping records of personal budgets to reporting the earnings of a business, computer technology is used by financial companies daily. Information technology allows the rapid calculation of financial statistics, as well as electronic transfers of money. *Information technology plays a huge role in financial services for many different reasons, but most importantly on the electronic networks that exchange information.* Because all financial transactions involve the exchange of information, the increasing popularity of online finance coincided with advances in information technology.

✓ Importance of IT for Finance industry:

- **Trading**

  Financial trading is enhanced with information technology. Some computer systems even trade for the users. A system is programmed to enter buy and sell orders when the price of a stock or bond reaches a certain level, and automatically closes the order when the target price or the stop-loss is reached. Computer based trading is useful when a trader has a system that allows profitable trading and does not want to enter each order individually. Information technology provides instant information for stock traders to make decisions, and allows them to enter orders that are immediately executed.

- **Reporting**

  Financial reports are also improved with information technology. The language known as XBRL, or Extensible Business Reporting Language, is used to standardize the financial information in public companies' annual reports. Traders can quickly sort through records in this format. They can easily find the statistical data they need to determine which companies to invest in. According to the California State University at Fullerton, XBRL is based on XML, the extensible markup language used to transfer information over the Internet.

- **Function**

  Financial data can be easily transferred with information technology. Instead of using checks and checking accounts, information technology can clear a transaction instantly. A debit or credit card purchase is rapidly compared with the user's account balance, allowing a bank to decide whether to allow a transaction. Information technology allows transactions during weekends and holidays, when there is no staff working at the bank.

- **Convenience**

  Personal finance is simplified using information technology. Banks provide data on checking and savings deposits and withdrawals in standardized formats. A customer can download account transactions and store them in records on a home computer. Personal finance software includes additional features, such as charts and reports, that show home users what they are spending money on and where their funds are coming from.

- **Budgeting and Bookkeeping**

  Information technology is also helpful for companies that are considering financial transactions. Computer systems calculate and display the interest and principal of a loan, and estimate the returns on investment when the company borrows money to expand its operations. Companies can securely transfer data online, and the computer system records all transfers, which simplifies bookkeeping.

10.6 APPLICATION OF IT IN HOTEL MANAGEMENT

Information Technology in the Hotel Industry is becoming more and more important to gain a competitive edge. Hoteliers are becoming more and more competent in terms of handling IT to skyrocket their businesses. The Hotel industry has acknowledged the importance of IT which is a win-win situation for all. Hotels can now focus on providing quality Hospitality services and best experience by using Information Technology.

✓ **Importance of Technology to the Hoteliers :**

- **Online Bookings**

  The most obvious manifestation of information technology in the hotel industry is in the bookings. The internet has helped to make it easy to access information.Data containing the check in and check out times, hotel rates, facilities and amenities on offer, as well as other vital information allows guests to make informed choices.By default, people now rely on various online platforms and Best Travel Websites to look for accommodation and make bookings; therefore, the hotel industry has capitalised on this.

- **Online Reputation**

  In a recent survey it was found that 93 % of people use online reviews while deciding to book a hotel and 53% of the potential guests would not book a hotel if there are no online reviews.Today's contemporary clientele is a lot more tech-savvy than it was a couple of years ago.Customers now see beyond the self-marketing pitches and are more likely to take official communication, even if it is accurate with a grain of salt.Guests are increasingly relying on reviews and recommendations from genuine travellers. Because of this, hotels are increasingly investing in enhancing their social media presence by hiring brand ambassadors, advocates and social media influencers.This helps to prove how central IT is to the Hospitality industry these days.

- **An Enhanced Guest Experience in Hotels**

  The latest advancements of IT in the hotel industry have played an instrumental role in enhancing the guest experience.The hotels can now grab the attention of the guests right from the time they visit the website. Winning customers loyalty is now within reach of all the hotels.Information Technology in the Hotel industry has made it easy to cover all the touch points for Guest experience.Guests are more in charge of their check out processes, and they can also make online payments if they wish to.Some hotels even allow guests to unlock their rooms using their smartphones, which eliminates the long and tedious check-in process.Likewise, it is also easier for guests to check out, which allows them to avoid the reception altogether.

- **Information Systems in the Hotel Industry**

  These systems provide the information required by the hotel for proper management of staff and the facilities. This system can be used to analyse and facilitate operational and strategic activities and is used functionally in areas such as security, housekeeping, maintenance, and financial controls and accounting. This system is important because it keeps track of payroll, labour, and sales, as well as generates records which may be useful for accounting purposes.

10.7 APPLICATION OF IT IN EDUCATION

Rapid progress of information and communication technologies is considered as one of the key factors of change in humankind society. The main impact of IT in education can be seen in improving the capabilities of instructors, changing the educational structure, creating opportunities for greater and more comprehensive learning, enhancing educational quality and improving teaching skills.

✓ **Importance of Technology to the Education sector:**

- Distance Learning Programmes : Modern technology has given way to a new kind of teaching methodology called distance learning programme. In this programme, teachers and students communicate by computers through telecommunication technologies. Internet is one of the tools of distance learning programme. Other tools used in distance learning are the telephone, audioconferencing, short-wave radio, audiotapes, television, film, videotape, and videoconferencing. Hard copy can be delivered through the mail or by fax, audio, video, and text can all be delivered through Internet. Internet makes learning accessible even in the most remote areas.
- Educational Software and Online Textbooks : In recent years, educational publishers have dramatically expanded their technology offerings by bringing educational software on Internet. They have prepared word processing programs with built-in grammar handbooks and writing tips and uploaded them on Internet servers for global access. Some publishers offer whole textbooks on disk or on the Internet.
- Sharing of Information : Another important benefit provided by Internet in education is the sharing of information among researchers worldwide. The Internet began as the

ARPANet, created by the Advanced Research Projects Agency (ARPA) for the purpose of allowing scientists around the globe to share information role of work together on projects. Today, the Internet still plays the important role of providing a place, a Cyberspace. In cyberspace, people can share information, ideas, discoveries, theories, proposals and other stock of the academic interest.

- **Computer Centres**: Many schools have created special facilities called learning labs or computer centers. In a computer centre, a number of computers are often connected via Internet and are made available to students for research and learning.
- **News Services**: Students can get daily news reports from online services, such as America Online (AOL), CompuServe, and prodigy. AOL, for example provides access to over one hundred magazines and newspapers through which the students can know what is currently happening in the world.
- **E-mail**: Many universities and colleges have E-mail systems that allow students, faculty members and administrators to communicate with one another through Internet.
- **Electronic Journals**: Many journals are now published on the Web which can be accessed depending upon the kind of subscription.

10.8 APPLICATION OF IT IN ENTERTAINMENT

Internet for Entertainment Internet is used for entertainment for the following purposes:

- **Movies** : One can download movies of various languages from around the world through Internet and watch them on the PC.
- **Chatting** : The most popular application of Internet for entertainment is Internet Relay chat or chatting. In chatting, people key in their messages which can be sent to other people through Internet. One can make friends from around the world and talk to them through chatting. One can also share their experiences by chatting.
- **Games** : One can download many kinds of games on the PC through Internet and play them.

10.9 APPLICATION OF IT IN HEALTH

As computer and technology use in hospitals, clinics and private practice expands, information technology is being used in countless ways to improve healthcare delivery, patient safety, and the relationship between patients and healthcare providers.

✓ Importance of Information Technology in Healthcare

- The challenge in the 21st century is a surplus of patient Information. The human brain, even a physician's brain, cannot keep up with the exponential growth in medical knowledge that will occur in forthcoming years. The most noteworthy use of IT is in patient records and data management. Healthcare professionals used to be tied to clunky paper charts that were easily lost, damaged or misinterpreted. Now, providers can track patient records securely and easily, appending pharmacy records, test results, X-rays and even vital signs to a virtual chart that's easier to read and share and that can also be checked against other databases.

- The ability of human to memorize things has remained flat, but the medical knowledge that needs to be assimilated is increasing geometrically. It is difficult for the human brain to memorize all the information at a given period of time. With the help of computer we can store massive amount of data and can retrieve it when required. Rapid technology advancements and continuous increase in performance/price indexes have made information technology (IT) applicable at all levels in health care organizations and patient management.
- It is difficult for physicians to keep up with the rapidly changing state of medical knowledge and to understand what these changes mean for the treatment of specific patients. In such situation IT based decision support system could help doctors to learn about new treatments.
- Health Information Technology (Health IT) allows comprehensive management of medical information and its secure exchange between healthcare consumers and providers.

REVIEW QUESTIONS

1. Explain the application of IT in Railways.
2. Elucidate the application of IT in Airlines.
3. Describe the application of IT in Banking.
4. Describe the application of IT in Insurance.
5. Explain the application of IT in Inventory Control.
6. Elucidate the application of IT in Financial System.
7. Describe the application of IT in Hotel management.
8. Explain the application of IT in Education.
9. Explain the application of IT in Entertainment.
10. Describe the application of IT in Health.

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11

CHAPTER

Security Issues in Information Technology

LEARNING OUTCOMES

- ☐ Introduction to IT Security
- ☐ Security attacks
- ☐ Malware
- ☐ Features of Security Mechanism
- ☐ Firewall

11.0 INTRODUCTION TO IT SECURITY

Information Technology Security also known as, IT Security is the process of implementing measures and systems designed to securely protect and safeguard information (business and personal data, voice conversations, still images, motion pictures, multimedia presentations, including those not yet conceived) utilizing various forms of technology developed to create, store, use and exchange such information against any unauthorized access, misuse, malfunction, modification, destruction, or improper disclosure, thereby preserving the value, confidentiality, integrity, availability, intended use and its ability to perform their permitted critical functions.

Various types of IT security are :

- **Network Security** : Network security is used to prevent unauthorized or malicious users from getting inside your network. This ensures that usability, reliability, and integrity are uncompromised. This type of security is necessary to prevent a hacker from accessing data inside the network. It also prevents them from negatively affecting your users' ability to access or use the network.

Network security has become increasingly challenging as businesses increase the number of endpoints and migrate services to public cloud.

• **Internet Security** : The Internet provides a wealth of information and services. Many activities in our daily lives now rely on the Internet, including various forms of communication, shopping, financial services, entertainment and many others. The growth in the use of the Internet, however, also presents certain risks. Just think about all the information you send over the Internet, such as personal messages, bank account information, photographs, etc.

As a typical Internet user, you have the reasonable expectation that your communications and transactions are private and secure. When you make a video call to a family member, you expect that nobody else is watching. When you buy something online with a credit card, you expect that nobody else can get access to your credit card details.

For the most part, the Internet is indeed private and secure, but there are a number of serious security risks. The protection to these risks may come in the form of firewalls, antimalware, and antispyware.

• **Endpoint Security** : Endpoint security provides protection at the device level. Devices that may be secured by endpoint security include cell phones, tablets, laptops, and desktop computers. Endpoint security will prevent your devices from accessing malicious networks that may be a threat to your organization. Advance malware protection and device management software are examples of endpoint security.

• **Cloud Security** : Applications, data, and identities are moving to the cloud, meaning users are connecting directly to the Internet and are not protected by the traditional security stack. Cloud security can help secure the usage of software-as-a-service (SaaS) applications and the public cloud. A cloud-access security broker (CASB), secure Internet gateway (SIG), and cloud-based unified threat management (UTM) can be used for cloud security.

• **Application Security** : With application security, applications are specifically coded at the time of their creation to be as secure as possible, to help ensure they are not vulnerable to attacks. This added layer of security involves evaluating the code of an app and identifying the vulnerabilities that may exist within the software.

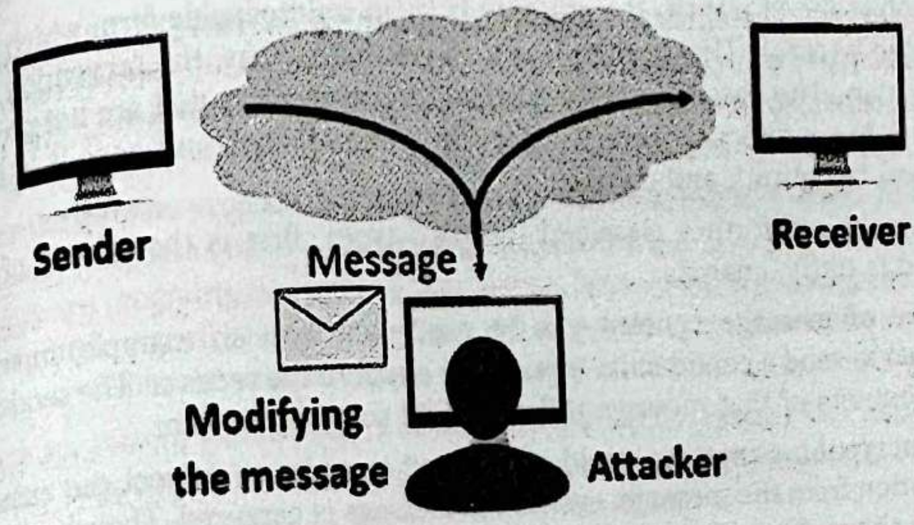
11.1 SECURITY ATTACKS

Security attack is an attempt to gain unauthorized access to information resource or services, or to cause harm or damage to information systems. There are two types of attacks – Active and passive attacks.

Active attacks are the attacks in which the attacker tries to modify the information or creates a false message. The prevention of these attacks is quite difficult because of a broad range of potential physical, network and software vulnerabilities. Instead of prevention, it emphasizes on the detection of the attack and recovery from any disruption or delay caused by it.

An active attack usually requires more effort and often more dangerous implication. When the hacker attempts to attack, the victim gets aware of it.

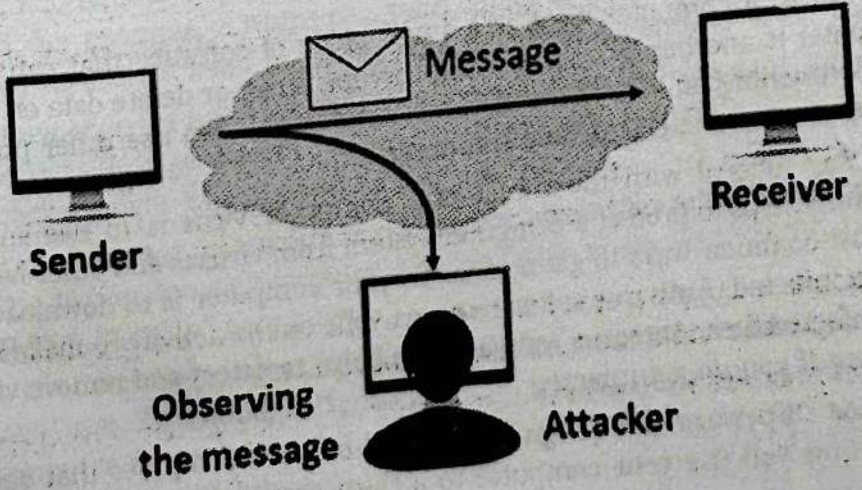
The active attacks are in the form of interruption, modification and fabrication.



- **Interruption** is known as masquerade attack in which unauthorized attacker tries to pose as another entity.
- **Modification** can be done using two ways replay attack and alteration. In the replay attack, a sequence of events or some data units is captured and resent by them. While alteration of the message involves some change to the original message, either one of them can cause alteration.
- **Fabrication** causes Denial Of Service (DOS) attacks in which attacker strive to prevent licit users from accessing some services, which they are permitted to or in simple words the attacker gain access to the network and then lock the authorized user out.

Passive attacks are the attacks where the attacker indulges in unauthorized eavesdropping, just monitoring the transmission or gathering information. The eavesdropper does not make any changes to the data or the system.

Unlike active attack, the passive attack is hard to detect because it doesn't involve any alteration in the data or system resources. Thus, the attacked entity doesn't get any clue about the attack. Although, it can be prevented using encryption methods in which the data is firstly encoded in the unintelligible language at the sender's end and then at the receivers end it is again converted into human understandable language.



In this way, at the time of transit, the message is in an unintelligible form which could not be understood by the hackers. That is the reason, in passive attacks, the prevention has more concern than detection. The passive attacks entangle the open ports that are not protected by firewalls. The attacker continuously searches for the vulnerabilities and once it is found the attacker gains access to network and system.

The passive attacks are further classified into two types, first is the release of message content and second is traffic analysis.

- The release of message content can be expressed with an example, in which the sender wants to send a confidential message or email to the receiver. The sender doesn't want the contents of that message to be read by some interceptor.
- By using encryption a message could be masked in order to prevent the extraction of the information from the message, even if the message is captured. Though still attacker can analyse the traffic and observe the pattern to retrieve the information. This type of passive attack refers to as **traffic analysis.**

11.2 MALWARE

Malware (short for "malicious software") is a file or code, typically delivered over a network, that infects, explores, steals or conducts virtually any behavior an attacker wants. Though varied in type and capabilities, malware usually has one of the following objectives :

- Provide remote control for an attacker to use an infected machine.
- Send spam from the infected machine to unsuspecting targets.
- Investigate the infected user's local network.
- Steal sensitive data.

Malware is an inclusive term for all types of malicious software, such as :

(*i*) **Computer Viruses** : One of the most serious threats consists of viruses and other harmful programs. A **computer virus** is a computer program that replicates itself into other computer programs and can cause damage to a computer's software, hardware or data. Once a virus is present on a computer, it typically performs some type of harmful action, such as corrupting data or obtaining sensitive information.

In other words, a computer virus is a small piece of software that can spread from one infected computer to another. The virus could corrupt, steal, or delete data on your computer—even erasing everything on your hard drive. A virus could also use other programs like your email program to spread itself to other computers.

The best way to deal with the threat of a computer virus is to use antivirus software. Antivirus software helps to protect a computer system from viruses and other harmful programs. One of the most common ways to get a virus on your computer is to download a file from the Internet that is infected. Antivirus software scans your online activity to make sure you are not downloading infected files. Antivirus software also helps to detect and remove viruses from your computer system if you do get infected.

(*ii*) **Spyware** : Spyware is a program installed on your computer that sends information about you and how you use your computer to a third party, typically without you being aware this is happening. Spyware often enters your system when you install some type of free software from an untrusted source. Installation of the program you were interested in also installs the spyware. Since you authorized the installation, conventional protection methods, such as antivirus software, do not prevent spyware from getting installed in this manner.

Once the spyware program is installed, it starts collecting information. Some spyware programs are relatively harmless and collect very generic information that does not personally identify you. Other spyware programs may record your actual keystrokes, including any passwords, and may search through any of your files looking for something that looks like a credit card number. These types of spyware programs can definitely be harmful.

Once spyware has collected its information, it sends this to whoever created the program. Again, this happens without you noticing it. Removing the spyware can be difficult - often the program installs itself again as quickly as you can delete it. To counter spyware, you need to use a dedicated spyware management tool. Some antivirus software is bundled with spyware management tools, but they are separate functions.

Malicious spyware is used to describe the Trojan application that was created by cybercriminals to spy on their victims. An example would be keylogger software that records a victim's every keystroke on his or her keyboard. The recorded information is periodically sent back to the originating cybercriminal over the Internet. Keylogging software is widely available and is marketed to parents or businesses that want to monitor their kids' or employees' Internet usage.

(*iii*) Rogue security software : Many times, a pop-up window appears that advertises a security update or alert. It appears legitimate and asks to click on a link to install the "update" or "remove" unwanted malicious software that it has apparently detected. This could be rogue security software designed to lure people into clicking and downloading malicious software.

(*iv*) Trojan horse : Users can infect their computers with Trojan horse software simply by downloading an application they thought was legitimate but was in fact malicious. Once inside the computer, a Trojan horse can do anything from recording the passwords by logging keystrokes (known as a keystroke logger) to hijacking the webcam to watch and record the every move.

(*v*) Computer worm : A computer worm is a software program that can copy itself from one computer to another, without human interaction. Worms can replicate in great volume and with great speed. For example, a worm can send copies of itself to every contact in your email address book and then send itself to all the contacts in your contacts' address books.

Because of their speed of infection, worms often gain notoriety overnight infecting computers across the globe as quickly as victims around the world switch them on and open their email. Example - Conficker worm (also known as Downadup).

(*vi*) Botnet : A botnet is a group of computers connected to the Internet that have been compromised by a hacker using a computer virus or Trojan horse. An individual computer in the group is known as a "zombie" computer.

The botnet is under the command of a "bot herder" or a "bot master," usually to perform reprehensible activities. This could include distributing spam to the email contact addresses on each zombie computer, for example. If the botnet is sufficiently big in number, it could be used to access a targeted website simultaneously in what's known as a denial-of-service (DoS) attack.

The goal of a DoS attack is to bring down a web server by overloading it with access requests. Popular websites such as Google and Twitter have been victims of DoS attacks.

(vii) Spam : Spam in the security context is primarily used to describe email spam — unwanted messages in the email inbox. Spam, or electronic junk mail, is a nuisance as it can clutter the mailbox as well as potentially take up space on the mail server. Unwanted junk mail advertising items etc, one doesn't care for is harmless and are not spams. However, spam messages can contain links that when clicked on could go to a website that installs malicious software onto the computer.

(viii) Phishing : Phishing scams are fraudulent attempts by cybercriminals to obtain private information. Phishing scams often appear in the guise of email messages designed to appear as though they are from legitimate sources. For example, you receive an email that is made to look as though it comes from a legitimate company you normally do business with. The email might tell you that some sort of service normally provided to you is due to expire soon. The email directs you to a phony Web site made to look like the site of the company you do business with. Once there, you are asked to provide personal information — such as a credit card or Social Security number — so that your service can be continued. When you will enter your details, they will be hacked by the cybercriminals.

(ix) Rootkit : A rootkit is a collection of tools that are used to obtain administrator-level access to a computer or a network of computers. A rootkit could be installed on your computer by a cybercriminal exploiting a vulnerability or security hole in a legitimate application on your PC and may contain spyware that monitors and records keystrokes

For example : Rootkits gained notoriety when, in 2005, a security blogger discovered that a copy-protection tool inside music CDs from Sony BMG Music Entertainment was secretly installing a rootkit when users copied the CD onto their computers.

(x) Email Spoofing : Email Spoofing is when an email message appears to have originated from one source when it actually was sent from another source. Email spoofing is often an attempt to trick the user into making a damaging statement or releasing sensitive information (such as passwords). Spoofed email can range from harmless pranks to social engineering ploys. Examples of the latter include :

- Email claiming to be from a system administrator requesting users to change their passwords to a specified string and threatening to suspend their account if they do not comply.
- Email claiming to be from a person in authority requesting users to send them a copy of a password file or other sensitive information.

(xi) Email-Borne Viruses : Viruses and other types of malicious code are often spread as attachments to email messages. Before opening any attachments, be sure you know the source of the attachment. It is not enough that the mail originated from an address you recognize. Also, malicious code might be distributed in amusing or enticing programs. Never run a program unless you know it to be authored by a person or company that you trust. Also, don't send programs of unknown origin to your friends or co-workers simply because they are amusing — they might contain a Trojan horse program.

11.3 FEATURES OF SECURITY MECHANISM

The commonly accepted aspects of security are as follows :

- **Identification and authentication** : *Identification* is the ability to identify uniquely a user of a system or an application that is running in the system. *Authentication* is the ability to prove that a user or application is genuinely who that person or what that application claims to be.For example, consider a user who logs on to a system by entering a user ID and password. The system uses the user ID to identify the user. The system authenticates the user at the time of logon by checking that the supplied password is correct.
- **Authorization** : *Authorization* protects critical resources in a system by limiting access only to authorized users and their applications. It prevents the unauthorized use of a resource or the use of a resource in an unauthorized manner.
- **Auditing** : *Auditing* is the process of recording and checking events to detect whether any unexpected or unauthorized activity has taken place, or whether any attempt has been made to perform such activity.
- **Confidentiality** : The *confidentiality* service protects sensitive information from unauthorized disclosure. When sensitive data is stored locally, access control mechanisms might be sufficient to protect it on the assumption that the data cannot be read if it cannot be accessed. If a greater level of security is required, the data can be encrypted. Encrypt sensitive data when it is transmitted over a communications network, especially over an insecure network such as the Internet.
- **Data integrity** : The *data integrity* service detects whether there has been unauthorized modification of data.There are two ways in which data might be altered : accidentally, through hardware and transmission errors, or because of a deliberate attack. Many hardware products and transmission protocols have mechanisms to detect and correct hardware and transmission errors. The purpose of the data integrity service is to detect a deliberate attack.

  The data integrity service aims only to detect whether data has been modified. It does not aim to restore data to its original state if it has been modified.

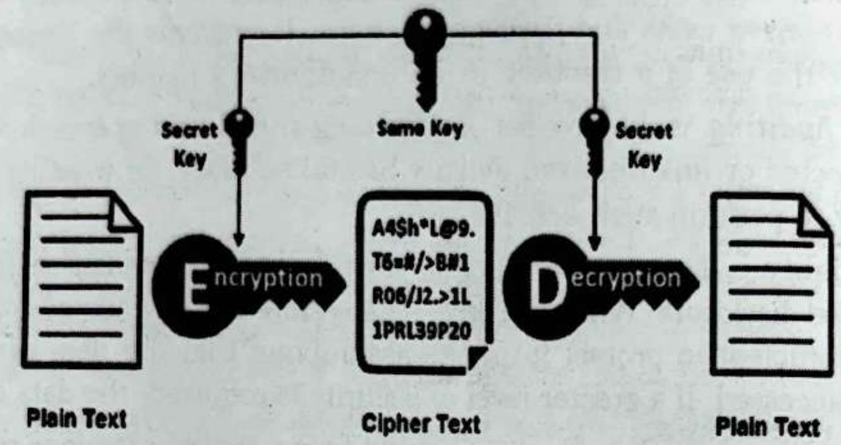
11.4 SECURITY MECHANISMS

Security mechanisms are technical tools and techniques that are used to implement security services. A mechanism might operate by itself, or with others, to provide a particular service. Examples of common security mechanisms are as follows :

(*a*) **Cryptography** : Cryptography is a method of storing and transmitting data in a particular form so that only those for whom it is intended can read and process it. The term is most often associated with scrambling plaintext message (ordinary text, sometimes referred to as plaintext) into ciphertext (a process called encryption), then back again (known as decryption). There are, in general, three types of cryptographic schemes typically used to accomplish these goals : secret key (or symmetric) cryptography, public-key (or asymmetric) cryptography, and hash functions, each of which is described below :

✓ **Symmetric cryptosystems :** This is the simplest kind of encryption that involves only one secret key to cipher and decipher information. Symmetrical encryption is an old and best-known technique. It uses a secret key that can either be a number, a word or a string of random letters. It is a blended with the plain text of a message to change the content in a particular way. The sender and the recipient should know the secret key that is used to encrypt and decrypt all the messages. Examples of symmetric systems are the data encryption standard (DES) and rotor ciphers.

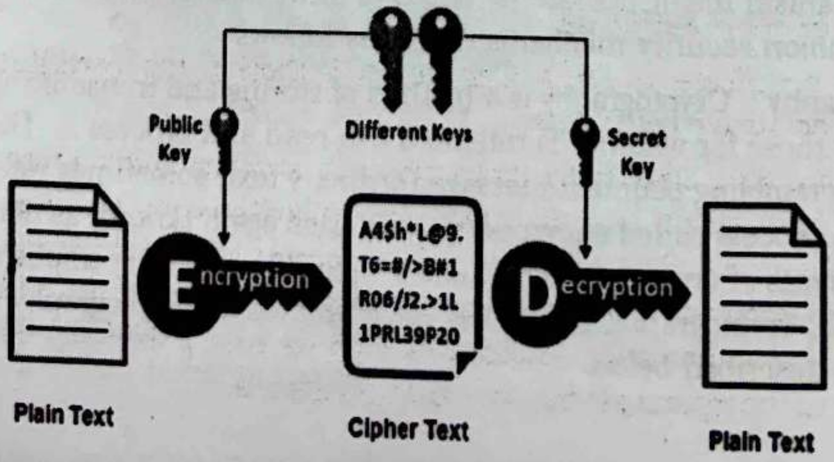
Symmetric Encryption


Secret Key
Same Key
Secret Key
Encryption
A4$h*L@9.
T6=#/>B#1
R06/J2.>1L
1PRL39P20
Decryption
Plain Text
Cipher Text
Plain Text

The main disadvantage of the symmetric key encryption is that all parties involved have to exchange the key used to encrypt the data before they can decrypt it.

✓ Asymmetrical encryption is also known as public key cryptography, which is a relatively new method, compared to symmetric encryption. Asymmetric encryption uses two keys to encrypt a plain text. Secret keys are exchanged over the Internet or a large network. It ensures that malicious persons do not misuse the keys. It is important to note that anyone with a secret key can decrypt the message and this is why asymmetrical encryption uses two related keys to boosting security. A public key is made freely available to anyone who might want to send you a message. The second private key is kept a secret so that you can only know.

A message that is encrypted using a public key can only be decrypted using a private key, while also, a message encrypted using a private key can be decrypted using a public key. Security of the public key is not required because it is publicly available and can be passed over the internet. Asymmetric key has a far better power in ensuring the security of information transmitted during communication.


Public Key
Different Keys
Secret Key
Encryption
A4$h*L@9.
T6=#/>B#1
R06/J2.>1L
1PRL39P20
Decryption
Plain Text
Cipher Text
Plain Text

Asymmetric encryption is mostly used in day-to-day communication channels, especially over the Internet. Asymmetric algorithms are slower but have the advantage that there is no key distribution problem.

(*b*) **Message digests** : A message digest is a fixed size numeric representation of the contents of a message, computed by a hash function. A message digest can be encrypted, forming a digital signature.

Messages are inherently variable in size. A message digest is a fixed size numeric representation of the contents of a message. A message digest is computed by a hash function, which is a transformation that meets two criteria :

- The hash function must be one way. It must not be possible to reverse the function to find the message corresponding to a particular message digest, other than by testing all possible messages.
- It must be computationally infeasible to find two messages that hash to the same digest.

The message digest is sent with the message itself. The receiver can generate a digest for the message and compare it with the digest of the sender. The integrity of the message is verified when the two message digests are the same. Any tampering with the message during transmission almost certainly results in a different message digest.

A message digest created using a secret symmetric key is known as a Message Authentication Code (MAC), because it can provide assurance that the message has not been modified.

The sender can also generate a message digest and then encrypt the digest using the private key of an asymmetric key pair, forming a digital signature. The signature must then be decrypted by the receiver, before comparing it with a locally generated digest.

(c) Digital certificates : Digital certificates protect against impersonation, certifying that a public key belongs to a specified entity. They are issued by the trusted third party known as a Certificate Authority (CA).

Digital certificates provide protection against impersonation, because a digital certificate binds a public key to its owner, whether that owner is an individual, a queue manager, or some other entity. Digital certificates are also known as public key certificates, because they give you assurances about the ownership of a public key when you use an asymmetric key scheme. A digital certificate contains the public key for an entity and is a statement that the public key belongs to that entity :

- When the certificate is for an individual entity, the certificate is called a *personal certificate* or *user certificate*.
- When the certificate is for a Certificate Authority, the certificate is called a *CA certificate* or *signer certificate*.

If public keys are sent directly by their owner to another entity, there is a risk that the message could be intercepted, and the public key substituted by another. This is known as a ***man in the middle attack***. The solution to this problem is to exchange public keys through a trusted third party, giving you a strong assurance that the public key really belongs to the entity with which you are communicating. Instead of sending your public key directly, you ask the trusted third party to incorporate it into a digital certificate.

11.5 FIREWALLS

In computing, a firewall is a network security system that monitors and controls the incoming and outgoing network traffic based on predetermined security rules. A firewall typically establishes a barrier between a trusted, secure internal network and another outside network, such as the Internet, that is assumed not to be secure or trusted. Firewalls impose restrictions on incoming and outgoing Network packets to and from private networks. Network firewalls filter traffic between two or more networks; they are either software appliances running on general purpose hardware, or hardware based appliances. They can also serve as the platform for IPsec. Using tunnel mode capability, firewall can be used to implement VPNs. Firewalls can also limit network exposure by hiding the internal network system and information from the public Internet. A firewall may be designed to operate as a filter at the level of IP packets, or may operate at a higher protocol layer. Firewalls can be categorized into following types :

- **Packet-filtering firewalls or Network layer (Layer 3) firewalls** make decisions based on the source and destination addresses and ports in IP packets. This basic form of firewall protection is really no more than a simple sorting algorithm. Generally they enable you to have some control through the use of access lists. Packet filtering can also often be performed by other network devices such as routers and is generally what you get when you download free firewall software. This type of firewall has little or no logging capability, making it difficult to determine if it's been attacked.
- **Circuit-level gateways** monitor the TCP handshaking going on between the local and remote hosts to determine whether the session being initiated is legitimate — whether the remote system is considered "trusted." They don't inspect the packets themselves, however.
- **Stateful inspection firewalls** not only examine each packet, but also keep track of whether or not that packet is part of an established TCP session. This offers more security than either packet filtering or circuit monitoring alone, but exacts a greater toll on network performance.
- **Application-level gateways (proxies)** combine some of the attributes of packet-filtering firewalls with those of circuit-level gateways. They filter packets not only according to the service for which they are intended (as specified by the destination port), but also by certain other characteristics such as HTTP request string. A system establishes a connection to the proxy, which serves as an intermediary, and initiates a new network connection on behalf of the request. This prevents direct connections between systems on either side of the firewall and makes it harder for an attacker to discover where the network is, because they don't receive packets created directly by their target system. While application-level gateways provide considerable data security, they can dramatically impact network performance.
- **Multilayer inspection firewalls** combine packet filtering with circuit monitoring, while still enabling direct connections between the local and remote hosts, which are transparent to the network. They accomplish this by relying on algorithms to recognize which service is being requested, rather than by simply providing a proxy for each protected service. Multilayer firewalls work by retaining the status (state) assigned to a

packet by each firewall component through which it passes on the way up the protocol stack. This gives the user maximum control over which packets are allowed to reach their final destination, but again affects network performance, although generally not so dramatically as proxies do. While inspection firewalls are the most secure, they are also rather complex and the most likely to be misconfigured.

REVIEW QUESTIONS

1. What are the types of IT Security?
2. Differentiate between active and passive attacks.
3. Explain the various forms of Malware.
4. What are the various features of Security Mechanism.
5. "*Security mechanisms* are technical tools and techniques that are used to implement security services". Explain the various security mechanisms.
6. What is Firewall? Explain the various types of Firewalls.